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TRANSACTIONS

OF THE

KANSAS

ACADEMY OF SCIENCE

VOL. IV.

1875.

PROCEEDINGS OF THE EIGHTH ANNUAL MEETING

OF THE

KANSAS ACADEMY OF SCIENCE.

The eighth annual meeting of the Kansas Academy of Science was held in the Senate Chamber, at Topeka, beginning at 3 P. M. October 12th, and closing at 10 P. M. October 13th.

Among the proceedings of the Academy, the following will be of public interest:

A resolution was presented and passed as follows:

"*Resolved*, That the increasing popular demand for scientific information makes it a duty of members of this Association to embrace every appropriate occasion to aid the efforts of those seeking the introduction of the natural sciences into the common schools."

A committee, consisting of Profs. W. K. Kedzie, M. V. B. Knox and B. F. Mudge, was appointed to draft resolutions in regard to the necessity for a geological survey of the State, for presentation to the Legislature. The following report was unanimously adopted as an expression of the opinions of the Academy:

"It is now notoriously the fact that tons of choice minerals and fossils of Kansas are being shipped by collectors to the cabinets of eastern universities.

"It is exceedingly important for the educational and scientific interests of the State that these valuable specimens should be detained in the cabinets of the State.

"There is also a constantly increasing demand for more accurate and intelligent information as to the coal, gypsum, salt and other resources of the State.

"It is also well known that much money has been wasted in this State, in useless mining enterprises, which might have been saved by proper geological knowledge. Therefore,

"*Resolved*, 1st, That in the opinion of this Academy, a thorough geological survey of the State is imperatively needed.

"2d. This survey is necessary to develop fully the coal, salt, gypsum, lead, zinc, building stone, ochre and other resources of the State.

"3d. That such a survey should also include a thorough investigation of the rain-fall, spring and river system and general water supply of the State.

"4th. That the material already accumulated by this Academy, including lists of plants, birds, minerals and insects of the State, will be gladly contributed to this work.

"5th. That not only would such a survey place us on an equality with the more advanced States of the Union, but must prove for the State a most profitable monetary investment."

The resolutions were given to the Executive Committee of the Academy, who were directed to act thereon in conjunction with the State Board of Agriculture.

The following papers were read:

Additions to the Catalogue of the Lepidoptera of Kansas, by Prof. F. H. Snow.

Observations on the Botany of Kansas, with list of Plants observed since last year, by Prof. J. H. Carruth.

Descriptions of the several stages of *Plagiodera scripta* Fabr.—by William Osburn.

Remarks on some Characteristic Fossils of Western Kansas, by Prof. B. F. Mudge.
On the Hot Bluffs of the Missouri River in Nebraska, by Prof. W. K. Kedzie.
On the San Juan Mining Region, by Dr. W. H. Saunders.
On the Habits of certain Larvæ, by Geo. F. Gaumer.
Catalogue of the Mammals of Kansas, with notes, by Prof. M. V. B. Knox.
On the Ozone in the Atmosphere of Kansas, by Prof. W K Kedzie.
Additions to the Catalogue of Kansas Birds, by Prof. F. H Snow.
On the Chalk of Kansas, by Prof G E. Patrick
On the Larva and Chrysalis of the Sage sphinx (*Sphinx lugens* Walker), by Prof. F. H. Snow.

The following officers were elected for the ensuing term of one year:

President — Frank H. Snow.
Vice Presidents — B. F. Mudge, J. H. Carruth.
Secretary — Joseph Savage.
Treasurer — R. J. Brown.
Curators — F. H. Snow, W. K. Kedzie, E. A. Popenoe.

The following commissions were also appointed:

GEOLOGY — B. F. Mudge, M. V. B. Knox.
CHEMISTRY AND MINERALOGY — W. K. Kedzie, G. E. Patrick.
MAMMALOGY — M. V. B. Knox.
ORNITHOLOGY — F. H. Snow.
ENTOMOLOGY: *Lepidoptera* — F. H. Snow; *Coleoptera* — E. A. Popenoe; *Hymenoptera* — William Osburn; *Diptera* — George F. Gaumer.
BOTANY — J. H. Carruth, John Wherrell.
ENGINEERING — F. W. Bardwell, William Tweeddale.
METEOROLOGY — J. D. Parker.
PHILOLOGY — D. H. Robinson.
Committee on Publication — B. F. Mudge, *Chairman;* A. Gray, F. H. Snow.
Committee on Local Arrangements — P. McVicar, *Chairman;* A. H. Thompson, E. A. Popenoe.

The Society adjourned to meet in 1876, in Topeka — the date to be announced by the Executive Committee.

E. A. POPENOE, *Secretary pro tem.*

OZONE IN KANSAS ATMOSPHERE.

By PROF. WM. K. KEDZIE, of the State Agricultural College.

We hear much from every quarter of the healthfulness so generally characteristic of the climate of Kansas; and no person long resident within the State can have failed to be strongly impressed by the unmistakable health-producing and health-sustaining features of Kansas atmosphere. None of us need to be reminded of the general immunity which we enjoy from the inroads of bronchial and lung difficulties; nor to recall the startling recoveries which we have all witnessed when invalids are brought into our midst completely prostrated by these maladies as they prevail in more eastern localities. I doubt not every thoughtful student has

carefully sought for the adequate causes which have brought about so admirable a sanitary result. Our altitude above the sea is considerable, and yet is manifestly insufficient to account for so well marked a condition. Our atmosphere is proverbially a dry one; but an arid climate is not necessarily a healthful one. Now it is far from being the object of this paper to attempt any solution of this interesting problem, in which so many elements must obviously enter, and in the discussion of which any unanimity of opinion is well-nigh impossible. It is simply my desire to call your attention as a possible explanation of our climatic superiority, to the existence of an element which has thus far received little attention among us: the Ozone, everywhere prevalent in Kansas atmosphere. Nor is it any part of my intention to present here any elaborate discussion of the nature of this element nor of its supposed relations to the conditions of health and disease. This element has now been known to chemists barely thirty-five years, and yet ever since its discovery in 1840, by Schonbein, of Basle, it has probably received from chemists more universal attention with less satisfactory results than any other one body. It is only recently that a prominent member of the British Association pronounced any attempt to investigate the nature or relations of Ozone, "a delusion and a snare," and the great majority of English and American chemists have seemed disposed to "take him at his word," as its investigation has been by them almost wholly neglected. The whole matter seems to have been left to the researches of a few German and French chemists whose half contradictory results have appeared only in disjointed articles in the foreign periodicals. Indeed but one volume of English authorship, making any pretentions to thoroughness in the matter, has appeared; and even in this the subject is treated in a most fragmental and unsatisfactory manner.

But notwithstanding this disheartening meagerness of knowledge of the nature of Ozone and of the conditions in which it appears, there can be no shadow of a doubt that the relations which it sustains to organic life in every form are of most vital importance, and that we to-day are more generally indebted for our sanitary well-being to its indirect influence than we have as yet any conception. Now we know this Ozone to be an allotropic form of oxygen. We know it to be commonly produced by the action of electricity on the oxygen of our common air. Its peculiar odor as thus produced has been known from the most remote antiquity. Homer, in his Odyssey, speaks of the atmosphere, after the passage of the thunderbolt, as being "quite full of sulphurous odor," and it is a common experience of those who have happened near a lightning stroke that it is instantly followed by this strong characteristic odor. A positive proof of this fact, however, was furnished by a Swiss scientist, Buchwalder, who, while traveling in the Alps, was overtaken by a violent thunder storm in which his guide was instantly killed by a lightning stroke, and the powerful odor was at once apparent. Shortly afterward he visited the laboratory at Basle, in which Schonbein was manufacturing a large quantity of Ozone for experiment, when he at once expressed his astonishment at the strong "smell of lightning" which he had just observed a few days before in the thunder storm on the Alps. Thus the identity of the phenomena was plainly established. The same odor may be observed around an electrical machine during its operation in a close dry room. The allotropic condition of Ozone, however, is best illustrated by a single experiment. We know that the metal silver remains bright and unaltered in dry oxygen gas. But let a strip of silver be enclosed in a tube of oxygen, and let a succession of electric sparks be passed through, Ozone will be produced and the silver will almost immediately become covered with a black

deposit which is nothing else than silver oxide. On heating this black deposit pure oxygen gas will be again given off. The views of Schonbein as to the nature of Ozone are not at the present day generally accepted. He looked upon oxygen as an electrically neutral body made up of an electro-positive and an electro-negative atom. Its condition then pictured itself to his mind as O+ O–, standing side by side. By the action of the electric current he considered its particles to become so altered in their mutual positions as to produce two distinct bodies: First, Ozone, represented O– O+ O–; second, Antozone, represented O+ O– O+.

This view is now, however, wholly abandoned. As to the existence of Antozone it is here entirely unnecessary to speak. It is now looked upon by the generality of chemists as probably nothing else than the per-oxide of hydrogen. Ozone itself is now regarded by leading authorities as merely condensed oxygen, with a density of one and a half times that of oxygen. Hence if we represent a working particle of oxygen by O_2, that of Ozone would be O_3. We would thus give it the equivalent 48. For the purposes of experiment we can produce Ozone by a great variety of methods: By a slow oxidation of phosphorous in a moist and confined atmosphere; by the decomposition of the vapor of sulphuric ether by the agency of a glass rod heated to temperature of 250° F.; or in large quantities by the decomposition of the permanganate of potassium by sulphuric acid. As evolved by all these methods it exhibits its remarkable properties: A colorless gas of a powerful, pungent odor (whence its name, which signifies "odor producer;") exerting a peculiar irritating effect upon the mucous membrane of the throat and lungs; and with the oxidizing characteristics of ordinary oxygen much intensified. It will attack metals and decompose binary salts which it is entirely beyond the power of ordinary oxygen to touch.

Thus much and briefly as to the nature of this remarkable body. Next as to its existence in our atmosphere. This is found by careful experiment to be all but universal, but varying immensely in degree and intensity as determined by surrounding circumstances, particularly the presence or absence of decomposing organic matter. The natural processes which produce Ozone in our atmosphere are most numerous and varied. Its production by atmospheric electricity has already been mentioned, and although the results from this cause are most startling it is not probable that its effects are at all proportionate to that of the numberless silent producers of atmospheric Ozone. Indeed it seems very probable that there is no process in nature in which oxygen is either absorbed or liberated in which there is not a proportionate quantity of Ozone evolved. Meissner has plainly proved that not only in rapid process of combustion, but in the slow processes of decay, a certain quantity of Ozone is produced, the greater portion, of course, instantly disappearing when brought in contact with the decomposing matter, but still a recognizable portion escaping undestroyed into the general atmosphere. The mere process of evaporation from large bodies of water is also a most powerful contributor of Ozone to the atmosphere. But above all these, the latest researches in this fascinating field have indicated a third possible and more powerful source still: the process of vegetable growth. We know that the processes of vegetable nutrition depend primarily upon the fixation of carbon, that is, the absorption of carbonic acid from, and the return of oxygen to, the atmosphere. Now Daubeny has proved by careful experiment upon a slow current of air passing over a living plant that the liberated oxygen thus produced was accompanied by indications of Ozone. No matter how minute the amount thus produced, when we consider the enormous extent to which this operation is everywhere in progress, we must look upon it as a

most probable and abundant source of Ozone to our atmosphere. This hypothesis, too, enables us to explain certain well known facts in vegetable nutrition otherwise inexplicable. Thus we know that many plants which contain the greatest amount of nitrogen in their composition are not always those which are most benefited by the use of nitrogenous fertilizers. Such plants are almost invariably large-leaved, exposing an immense foliage surface. Hence the query naturally arises whether these plants may not have the power of supplying themselves with nitrogen compounds through the indirect action of the Ozone exhaled from their foliage. We know that this element has the power of oxidizing the nitrogen of the atmosphere first into nitrous and then into nitric acids, which in combination with the atmospheric ammonia might thus be furnished the plant in no insignificant quantity.

But from whatever source produced, it is obvious that by far the larger portion of our atmospheric Ozone must, on account of its intense oxidizing powers, be almost instantly consumed by decomposing organic matter wherever present. Hence is explained the circumstances in which we find the most abundant evidence of its existence. The atmosphere immediately surrounding stables or outhouses, or over decaying refuse heaps will afford not the slightest trace of Ozone; not, we are to understand, that it may not be there produced, but, when formed, it is at once consumed by the oxidizing processes in progress in such localities. Hence we are not surprised to learn that in cities the indication of its presence are much more feeble than in the pure air of the country uncorrupted by organic effluvia. Even in so moderately a populated city as Manhattan, I have found the result of my Ozone observations much less striking than in the fresher atmosphere of College Hill, two miles away. In the atmosphere of Topeka I have found its amount still less. In densely populated, and especially in manufacturing cities, we of course find the diminution more startling still. The city of Lyons, France, has positively afforded not a single indication of the presence of Ozone, and so proverbially is this the fact that it has been dubbed among French chemists, "the town without Ozone."

In comparing the results of diverse seasons also we very naturally find its quantity in winter fully twice that in summer. This is accounted for not only by the fact that in the winter season our electrical conditions are much more energetic and intense, but more especially by the circumstance that the greater proportion of the Ozone then produced in the atmosphere remains there undestroyed, the process of oxidation being then nearly at a stand-still and the organic matter of the earth frequently protected by a deposit of snow. For precisely similar reasons we find the reaction for Ozone much stronger at night than during the day. The maximum amount for the entire twenty-four hours is almost invariably just before sunrise; as by the condensation of watery vapor always taking place at that time, the air is freed from its organic impurities. But it is obvious that the amount of Ozone which we can measure in our atmosphere affords not the least indication of the amount which may have been produced there, for it is only possible for us to measure the residuum, that which remains undestroyed by oxidizable matter.

It is to be seriously regretted that the methods for quantitative estimation of Ozone should be so imperfect and so liable to grave error. Numerous methods for such estimations have been devised, the greater proportion of them dependent upon its well-known oxidizing power. It is well known that Iodide of Potassium is perfectly unalterable in oxygen gas. Under the action of Ozone, however, it is instantly decomposed, caustic potassa formed and free Iodine liberated. A test paper has hence been constructed in which wine-red litmus paper is impregnated with a solution of Potassium Iodide and exposed to the action of the Ozone of the

atmosphere. The extent to which this paper is blued by the action of the caustic potassa produced affords a basis for determining the amount of atmospheric Ozone present.

For my own uses, however, I have preferred a test of Schonbein's own devising. It is dependent on the well-known property which free Iodine possesses of turning starch an intense blue color; a reaction so delicate that it will detect one part in a million. In the manufacture of the test paper I use the proportion, 1 part of Potassium Iodide to 10 of starch; first, boiling the starch in an excess of 200 parts of distilled water, and, when the mixture is cold, adding the Potassium Iodide. In this, strips of unsized paper are soaked and afterward dried carefully in the dark and in air as absolutely free from impurities as possible. As a basis of comparison I employ a color scale, by which the proportion of Ozone, varying from the merest trace to an abundant presence, is indicated by a series of ten corresponding blue colors, gradually deepening from the first to the tenth. Now, on exposing a slip of this prepared paper to the action of the atmospheric Ozone for a period of twelve hours, free Iodine will become liberated in it to an extent proportionate to the quantity of Ozone in that atmosphere. If the exposed slip be then dipped in water, a blue color from the resulting action of the Iodine upon the starch will then be produced, and by comparing this with our color scale the number of the corresponding color may then be recorded as the result of the observation. Thus a basis is formed by which observers in different countries are enabled by the use of these numbers to compare the results of their investigations. As a necessary precaution the test paper must be preserved in the dark, as the action of intense light itself will in time decompose the Potassium Iodide. When exposed also it must be carefully protected from violent wind, from direct sun-light or even from directly reflected sun-light This I find is easiest to accomplish by suspending the slip in a plain wooden box without bottom and drilled abundantly with holes to allow a free access of air.

Employing this test of Schonbein's as a basis, the observations upon the quantity of Ozone, which for the year past have been in progress at the Agricultural College, have been most interesting and gratifying. They have established beyond a doubt the existence of an abundance of Ozone in the atmosphere of Kansas. While such observations can of course prove of value only when extended through a long period of years, results of great interest have already been obtained. Two series of daily observations have been made. First, a day observation, the result obtained by exposing the paper from 7 A. M. to 2 P. M. Second, a night observation, the result of which is best obtained by an exposure from 9 P. M. to 7 A. M. The relations of the two are well shown in the means of the observations for the month of January. The average of the day records for this month was 6.03; that of the night 7.50. In four observations for the night records of January, the scale gave the maximum number 10. During the succeeding months these numbers slowly decrease. For the month of May, for instance, the daily average has become 5; for that of July it has fallen to 3.53; in August, to 3.77; while in September it has again risen to 4.75; and thus it will go on increasing until the succeeding January. Moreover, during the summer months the difference between the day and night observations becomes less and less, those of the day sometimes even exceeding those of the night.

Probably one of the most extensive series of observations of this character in the United States has been that conducted by the Chemical Department of the State Agricultural College of Michigan, and I have been much interested in noticing by comparison how uniformly the results obtained in Kansas exceed those of Michigan. I here append a table giving the means of the day and night observations in

the two States for the first eight months, from January to August inclusive, of the year 1875:

MONTHS.	Kansas.		Michigan.	
	Day.	Night.	Day.	Night.
January	6.03	7.50	5.52	5.93
February	5.66	7.82	5.78	6.57
March	5.36	5.88	5.70	6.19
April	5.26	6.25	3.73	8.96
May	5.00	5.00	3.19	4.03
June	6.00	6.00	3.96	3.66
July	3.53	3.28	3.52	3.22
August	3.77	4.00	3.68	3.68

Moreover, this element of Ozone in our atmosphere, while of itself most vitally important, is above all valuable as establishing a pure atmosphere, one practically free from organic effluvia, the acknowledged source of malarial disorders.

But it is obviously entirely beyond either the limits or province of this paper to attempt any consideration of the complex relations of Ozone to health and disease. At some future meeting of this Academy it may perhaps be my privilege to attempt some such discussion. Probably no problem could be mentioned in which the opinions maintained by prominent scientists have been so discordant and so chaotically diverse. By one class of disputants the very possibility is denied of any connection between the presence of Ozone and the prevalence or absence of certain types of disease. On the other hand, by another party equally eminent it is maintained that the relations of this element to sanitary conditions are of most vital and paramount importance; and that it only remains for us to reveal them by careful research. Leading spirits of this latter party have expressed a firm belief in the near proximity of a period of enlightenment, when in addition to piping our dwelling-houses for water and gas, we shall not only add an additional pipe for carbonic acid under pressure to shield us from the dangers of conflagration, but above all a fourth tube for regulating our domestic atmosphere by a well directed stream of Ozone. Indeed it is only recently that a stock company was organized to this end in the city of Chicago, having as its consulting oracle a well-known western chemist, and for its avowed object the manufacture, upon an extended scale, of Ozone for the purification of the private residences, public buildings and sluice-ways and sewers of that most odorous city. Unfortunately, however, the efforts of this company prematurely terminated in a prospectus soliciting purchasers of stock! Enthusiasts in this matter must bear in mind that the presence of an excess of this Ozone is scarcely to be less deplored than its utter absence. It is well known that when existing in the atmosphere in too great an abundance, it occasions attacks of bronchitis and other bronchial disorders. An explanation has been thus suggested by medical authorities of the prevalence of these diseases, in certain seasons, in northern Minnesota.

What is above all now needed is a general series of careful, patient and conscientious observations extending through long periods of years. It is only from such a foundation of well authenticated facts, that we can hope to deduce results of any importance. The investigators of America are now rapidly awakening to the importance of this work. Earnest observers are beginning thorough records in various portions of the United States. It has been my object to call the attention of the gentlemen of this Academy to the importance of organizing a series of careful records of the Ozonic phenomena of Kansas. To any one disposed to assist in this work I shall take pleasure in furnishing color scales, Iodized paper and record

blanks, simply requesting that a copy of these be returned to me at the close of each month for tabulation.

The solution of this question is destined to become, from a chemical standpoint, one of the most important problems of the century before us; but a problem whose solution can only be purchased by long years of untiring study.

KANSAS STATE AGRICULTURAL COLLEGE, October, 1875.

THE NEBRASKA HOT BLUFF.

By PROF. WM. K. KEDZIE, of the Kansas State Agricultural College.

The somewhat startling natural phenomenon to which it is the object of this paper to call attention, is a bluff of the Missouri river, on the northern boundary of Nebraska, and near the village of Ionia. It is also not very far distant from the opposite town of Yankton, Dakota, and has been principally visited and described by prospectors from the latter city.

It is in appearance a quite ordinary river bluff, about a thousand feet in length, one hundred and fifty feet high, and sloping from the river by which its base is washed at an angle of seventy or seventy-five degrees. By the undermining action of the river a large mass, some five hundred feet long, one hundred feet high, and twenty to thirty feet thick, was some months ago scaled from the face of the bluff and fell to its base, forming a large mass of debris rising at some points fully forty feet above the level of the river. It is this immense fragmental mass which has displayed the striking phenomena so terrifying to the ignorant and superstitious of the neighborhood, and which very beautifully illustrates the important chemical transformations constantly in progress within the earth's crust.

Attention was first called to the peculiarities of this locality by a party of miners who were prospecting for indications of coal veins. On passing over this mass of debris, they found steam escaping from the crevices at every point. The ground was also perceptibly heated, and by placing the ear to the earth a crackling sound was heard proceeding from below. An opening was made in the mass to the depth of two feet, when the heat became so intense as to be scarcely endurable. Upon perforating the heap still further with an ordinary augur, the temperature was found to be rapidly increasing with the descent. An ordinary thermometer with a range of one hundred and fifty degrees was thrust into the augur-hole thus made, when the mercury shot up so rapidly to the top of the tube that it had to be instantly withdrawn to prevent the bursting of the bulb. All these circumstances carefully considered seemed to indicate that the temperature of the interior of the mass was fully 212° F. The exterior was, as a rule, coated with a hard incrustation of mineral salts brought up by capillary action from below; on breaking this the interior was found in a fine pulverulent condition, closely resembling the slacking process of lime. The intense heat of the mass made itself felt for many square rods around, and the steam escaping from the crevices was of a peculiarly sour, pungent odor. The mass is completely impenetrated by an abundance of beautiful crystals of Selenite (Gypsum); many of the crystals microscopic, others aggregated

into masses of considerable size, and others still most perfectly rhomboidal crystals upwards of a pound in weight. Peculiar incrustations are also noticed on the face of the partially decomposed rock, in some cases in the form of a white flaky powder, having the taste of common alum; in others in the form of efflorescent crystals giving the marked flavor of Epsom salts. As already intimated the superstitious denizens of this region at once leaped to the conclusion that a young volcano had burst upon them in all its fury, and fortified themselves with due courage to meet the emergency. Attracted by their somewhat exaggerated accounts, Mr. A. W. Barber, the editor of the Yankton Press, visited the locality and made a careful and intelligent examination. It is to his courtesy that I am indebted for an interesting box of specimens of the minerals here undergoing such vigorous transformations, and for a full account of the nature of the bluff. A chemical examination of these specimens reveals at once the nature of the interesting transformations here in progress, which, while known to be actively in operation in many localities in Europe, have as yet been observed at comparatively few points within the limits of the United States.

This so called "hot bluff," then, consists of two separate and mineralogically distinct ingredients. The main portion of the bluff from the base up to the height of a hundred feet consists of a bluish gray rock of uniform texture, somewhat schistose, soft and easily yielding to the knife, and to the eroding action of the river. So evenly balanced are its constituents that it seems a matter of question whether it should be properly called an argillaceous limestone, or a calcareous slate or argillite. For while upon analysis it is found to contain but about twenty per cent. of the earthy carbonates of calcium and magnesium, it yet offers all the characters of a magnesio argillaceous limestone, effervescing but slowly in cold acids, but with quite violent action upon elevation of the temperature.

Next above this the upper and remaining fifty feet of the bluff is completely interwoven with seams of varying thickness of a soft, friable, blue-black shale, in which exist in great quantity microscopic crystals of the bi-sulphide of iron (FeS_2), commonly known as iron pyrites. Nuggets of the same mineral are also found abundantly distributed over the face of the bluff. Now it is the products of the decomposition of this iron pyrites which form the active agents of all the violent chemical reactions here observed. We know that when exposed to the influence of atmospheric oxygen and moisture this mineral is rapidly decomposed, absorbing oxygen and becoming converted into Ferrous Sulphate, ($FeSO_4$), commonly known as green vitrol, and free sulphuric acid. Represented by formulæ, this change would be: $FeS_2 + H_2O + 7O = FeSO_4 + H_2SO_4$. This Ferrous Sulphate again on more extended exposure is still further oxidized and becomes Ferric Sulphate or Sesqui-Sulphate of Iron ($Fe_2 3S O_4$). This in its turn is a very unstable compound, and when brought in contact with other bases readily yields up its sulphuric acid and becomes converted into the hydrated oxide of iron. When exposed in considerable mass, this decomposition of iron pyrites of course proceeds but slowly, and specimens are frequently found illustrating the change in all its gradations. But when, as in the soft shale of this Nebraska bluff, it is found in the form of fine crystals appearing as glistening specks to the naked eye, its decomposition is very rapid and an abundance of free sulphuric acid is produced. Hence it will hardly be a matter of surprise when I state that the soft shale from the upper layers of this bluff has become so charged with free sulphuric acid as to be strongly sour to the taste and acid in reaction. In fact, on allowing a specimen of this shale to remain undisturbed in my laboratory for several months it was

found to afford 5.35 per cent. of sulphuric acid in the form of the freely soluble sulphates of iron and aluminum.

Thus we have in the chemical constitution of this hot bluff a perfect explanation of the startling phenomena which are there occurring. Below, a rock largely consisting of earthy carbonates freely decomposable by the presence of free acids. Above, a series of layers completely charged with an abundance of this free acid. When, by the scaling off of the face of the bluff, these agents are intimately mixed in an immense mass of thousands of tons of debris the free acid immediately attacks the easily yielding carbonates with great violence, and a "hot bluff" very naturally springs at once into existence. The intense degree of heat produced, however, is from another and more complex cause than this. If the simple acid shale were by itself without the limestone, piled in a large heap, and water added, there would be a very rapid rise of temperature within from the greatly increased rapidity with which the process of the oxidation of the iron pyrites would go on under these circumstances. It is well known that in the shales of Whitby, Eng., when thus piled and moistened with water, the oxidation of the pyrites will develop so intense a degree of heat as to spontaneously set fire to the bituminous matter which the shale contains. But when, as in the case of this Nebraska bluff, to the heat generated by this rapid oxidation produced by increased exposure to air and the water of the river and rains, there is added the violent avidity with which the free sulphuric acid attacks the carbonates of lime and magnesium, the effect is naturally powerful and startling in the extreme.

Under these encouraging conditions many interesting chemical compounds are here in the process of formation. By the decomposition of the carbonate of calcium by the sulphuric acid, magnificent crystals of Selenite (Gypsum), are now forming in immense abundance. The crystals are exceedingly perfect and beautiful; many of them somewhat rare in form, long, slender, needle-shaped crystals, but still perfect rhomboidal prisms with bevelled edges In some instances in the solid mass of the bluff itself, where the layers of the limestone and the acidified shale are conjoined, there are formed seams of a half inch or more in thickness completely filled with interradiating crystals of Selenite partially coated with the yellow hydrated oxide of iron. By the decomposition of the magnesium carbonate there is here formed magnesium sulphate or Epsom salts distributed over the rock in a very minute incrustation of efflorescent crystals.

Finally, by the slow decomposition of the argillaceous or clayey portions of the rock itself there is produced the Sulphate of Aluminum in minute crystalline tufts called on account of its form "Feather Alum." These last two compounds suggest an economical phase of what has thus far been simply an exceedingly interesting chemical phenomenon. It is well known that the great proportion of the common alums are manufactured from shales almost identical in nature with those which form the black seams of this Nebraska bluff. In the great English alum fields, for example, the shale, full of partially decomposed pyrites, is collected, piled in oblong heaps, and slowly fired to completely carry out the oxidation which has been begun. A large quantity of free sulphuric acid is thus produced which attacks the shale forming Aluminum Sulphate. This is removed by leaching with water and the addition of some available form of potash or ammonia is all that is needed to crystallize out the common potash or ammonia alums of commerce. Now, in the case of this Nebraska bluff, this oblong mass of heated debris bears no very distant resemblance to a "curing heap" of an alum manufacturer. The presence of the limestone is, to be sure, most unfortunate, and would necessarily be avoided if the

acidified shale was to be handled with a view to profit. The small quantity of the magnesium carbonate present would be by no means unpropitious, as the manufacture of Epsom salts and the alums is frequently carried on together at a handsome profit. If the accounts of intelligent observers are to be accepted, there would seem to be little doubt that this region may prove available in these branches of manufacture. But whether thus utilized or not, this display is surely a most fascinating one to the chemist and mineralogist—nature seeming, in some degree, to have pulled aside the curtain and given us a peep behind the scenes, where we are permitted to see her in the very act of forging these marvels of crystalline creation.

KANSAS CHALK.

By G. E. PATRICK, Professor Chemistry and Physics, Kansas University.

The existence of chalk in North America is a comparatively new fact in science. Prof. Dana, in his Manual of Geology, (editions previous to the last, 1874,) says, in speaking of the Cretaceous beds of this country, "they include in North America *no chalk*." Within the last few years, however, it has become generally known to the scientific men of Kansas, that there occur, in the Cretaceous formation of this State, vast beds of what must be considered a *true chalk*. Specimens of this have been sent to Prof. Dana for examination, with the result that in the last edition of his Manual, (1874,) he corrects the statement above quoted, and acknowledges the existence of chalk in the Cretaceous of Kansas.

The beds are of great extent, so great that in case a demand for it should ever arise, the supply would be practically limitless. They are in the western part of the State, from three hundred to three hundred and twenty miles west of Kansas City, and within three miles of the Kansas Pacific Railroad.

The chalk is, as a rule, very soft and fine grained, though in this respect it varies with the amount of impurities. The color of many specimens I have seen, is a snowy white; but a large portion of it is slightly tinged with yellow, by oxide of iron.

Examined under the microscope, it appears perfectly amorphous—a simple aggregation of shapeless particles. The Rhizopod shells, which almost universally occur in the chalk of the Old World, sometimes comprising nearly its entire substance, seem to be quite wanting in our Kansas chalk. With a good microscope, and a high power, I have been unable to detect any trace of them.

To believe that these shells were originally in the chalk, during its formation and subsidence, and that by water action they have become so completely disintegrated as not to leave a trace, involves too great an assumption; hence it is my opinion that our chalk was not formed, like that of England and France, by the aggregation of myriads of Rhizopod skeletons—that it is not in any way the product of animal life—but that its origin was purely chemical. The absence of flint, as far as observed, seems also to add weight to this view.

The amount of impurity varies of course, in different samples of the chalk, but in no specimens that I have seen does this amount exceed fifteen to sixteen per cent.

Two samples yielded, upon analysis, the figures given below. No. 1 was a fine specimen, of snowy whiteness; No. 2 had a light yellowish tinge, and was as poor a sample as I could select.

	No. 1.	No. 2.
Moisture	.34	.58
Insoluble in acids,(silicia, lime and alumina.)	.69	11.40
Alumina, (little oxide of iron,)	.43	.97
Ferrous carbonate	.14	2.83
Calcium carbonate	98.47	84.19
	100.07	99.97

The value of these deposits, from a practical point of view, I believe to be considerable; and that this value may be realized, capital and enterprise only are needed.

Among the possible uses to which this material may be applied, I would mention, as giving the greatest promise of profit, the manufacture of whiting of the various grades, for putty, for calcimining, et cetera; and the manufacture of Portland cement. The latter is a branch of industry not yet established in the United States; and this simply for the reason that in the older States where such a manufacture would otherwise have arisen, chalk, an essential in the economical manufacture of this cement, was not to be found.

One other essential, (and the only other), is clay. Only where these two materials are found in quantity, can the manufacture be most profitably carried on; and these conditions are fulfilled in this country, as far as our present knowledge extends, only in this State.

Portland, on account of its vast superiority over our American cements, has, in our growing cities, a large sale — which, however, is checked by its high price consequent upon importation. Its price is from two to five times that of the various American cements.

Common hard limestone *can* be used instead of chalk, in the manufacture of Portland, by previously grinding it to a fine powder in a mill; or by burning it to lime in a kiln, and then slaking. But the consumption of power required to reduce it to powder, or of fuel used in the extra kilning, places it under great disadvantage when compared with chalk.

With this disadvantage in view, however, General Gilmore, Major Corps of Engineers U. S. A., has estimated accurately the cost per ton of making Portland cement in this country, *using hard limestone instead of chalk.** After computing the exact cost at current prices, and adding a margin of twenty per cent. for contingencies, he sums up as follows: "In the United States the cost would not vary greatly from $10.00 per gross ton. * * * * * This estimate is believed to be a liberal one. It shows that Portland cement can be manufactured in this country at a cost less by from twelve to fourteen per cent. than the wholesale market price of Rosendale, omitting the cost of barrels in both cases."

Making use of chalk, instead of hard limestone, this cost would be very greatly reduced.

A large number of manufacturing experiments, which I have conducted upon a small scale in the laboratory, have proved by practical demonstration, that there

* Professional Papers of Corps of Engineers of U. S. A., Number 19.

can be made from materials at hand in this State, a Portland cement quite as good in quality as the imported article; and that this can be done in Kansas at an expense much less than in any other State in the Union, is equally well established.

ANALYSIS OF KANSAS SOILS.

By G. E. PATRICK, Professor of Chemistry and Physics, in University of Kansas.

I have recently submitted to analysis samples of two soils from Wallace county, Kansas. As the results show them to be quite rich in certain elements of plant-food, and as no soils from that part of the State have heretofore been analyzed, it may not be out of place to submit a report of my analyses to the Academy.

Both samples were collected in September, 1875, by Mr. S. W. Williston, member of Professor Mudge's geological party. Neither of the plats from which they were taken has ever been cultivated.

Both samples were thoroughly air-dried, at ordinary temperature of the laboratory, before analysis.

SAMPLE NO. 1.

This was an upland soil, taken from the high prairie of Smoky Hill Valley, near Monument Rocks, Wallace county.

It yielded upon analysis:

Water		3.449
Organic matter		5.224
Soluble in cold hydrochloric acid	Oxide of Iron	1.778
	Alumina	.721
	Lime	1.618
	Magnesia	2.084
	Potassa	.202
	Soda	.002
	Silicic acid	.023
	Sulphuric acid	.078
	Carbonic acid	2.567
	Phosphoric acid	.118
	Sodium chloride	.009
Insoluble in cold hydrochloric acid		82.127
		100.000

SAMPLE NO. 2.

This sample was taken from the upper loam of the Smoky Hill Valley bottom lands, thirty miles east of Fort Wallace, Wallace county.

It yielded upon analysis:

Water		1.895
Organic matter		3.039
Soluble in cold hydrochloric acid	Oxide of Iron	1.503
	Alumina	.557
	Lime	4.268
	Magnesia	.422
	Potassa	.214
	Soda	.038
	Silicic acid	.050
	Sulphuric acid	.041
	Carbonic acid	3.510
	Phosphoric acid	.173
	Sodium chloride	.003
Insoluble in cold hydrochloric acid		84.287
		100.000

One fact indicated by the above figures deserves special notice, namely, that of the alkaline bases present in the soluble portion of both these soils, potassa constitutes nearly the entire amount, while soda is found in but small quantity, especially in No. 1, where it is well nigh absent.

Considering that these soils have never been treated with fertilizers, the amount of phosphoric acid is almost exceptionally large.

The better to illustrate these points, and to facilitate general comparison, I have arranged these analyses, together with those of four other soils, in the following table. Nos. 1 and 2 are the Wallace county soils; No. 3 is from a plat in Wyandotte county, Kansas, that had been for eighteen years in blue-grass; No. 4 is an English clover soil, considered good; Nos. 5 and 6 are from Belmont county, Ohio, both upland; No. 5 a surface soil; No. 6 a subsoil.*

		Wallace county upland.	Wallace county bottom.	Wyandotte Co.	England.	Belmont Co., Ohio, upland surface soil.	Belmont Co., Ohio, upland subsoil.
		No. 1.	No. 2.	No. 3.	No. 4.	No. 5.	No. 6.
Water		3.449	1.895	3.800	.....	2.260	2.220
Organic matter		5.224	3.039	5.440	5.340	7.740	4.400
Soluble in hydrochloric acid.	Oxide of Iron	1.778	1.503	2.575	6.070	8.327	6.810
	Alumina	.721	.557	4.325	4.510		
	Lime	1.618	4.268	.675	4 205	1.550	2.830
	Magnesia	2.084	.422	.063	1.270	2.333	3.343
	Potassa	.202	.214	.048	.520	.920	.027
	Soda	.002	.038	.125	.160		
	Silicic acid	.023	.050	.....	.....	.....	.....
	Sulphuric acid	.078	.041	.386	.190	2.340	2.820
	Carbonic acid	2.567	3.510	.....	3.305	.....	.....
	Phosphoric acid	.118	.173	.080	.150	.032	.087
	Sodium Chloride	.009	.003	.045	.030	.....	.....
Insoluble in hydrocloric acid		82.127	84.287	82.157	73.840	74.498	77.463
		100.000	100.000	99.719	99.590	100.000	100.000

ANALYSIS OF SALT.

By G. E PATRICK, Prof. of Chemistry and Physics, in University of Kansas.

The purity of Kansas Salt, although its manufacture is a new industry in the State, has already been the subject of considerable remark. While it is very improbable that *all* the brines of the State will furnish salt of remarkable purity, yet it is worthy of notice, as a promising fact, that of those thus far examined, nearly every one has yielded a salt of most excellent quality.

To the number of such brines already known, I have one to add. The sample was from Great Bend, Barton county, and was taken from a well, at a depth of about four feet below the surface of the ground. Collected by Prof. B. F. Mudge. It was clear and sparkling, and very nearly free from calcium and magnesium carbonates,

* Nos. 3 and 4 are taken from the Report for 1874, of the Kansas State Board of Agriculture. Nos. 5 and 6 are from the Report of the U. S Commissioner of Agriculture. for 1869.

which when present in quantity are troublesome, from the fact of their deposition upon boiling, in the form of "scale."

It showed a specific gravity of 1.062 or 8.8 Baumé — a great density considering that it was almost a surface water. Its contents of pure salt was one bushel, to about 95 gallons of the brine.

I have analyzed two samples of salt made from this brine, the samples being taken from salt made at different times, as a check against untrustworthy results, from accidental impurity or excessive purity.

Both salts were made with no extra precautions to insure purity, and fairly represent the quality of the marketable article for table use.

They gave upon analysis:

	No. 1.	No. 2.
Sodium Chloride,	96.24	96.06
Magnesium Chloride,	1.22	1.56
Sodium Sulphate,	1.65	1.87
Calcium Sulphate,	.89	.51
	100.00	100.00

The entire absence of calcium chloride is a merit of this salt not to be overlooked.

CALAMITES.

By M. V. B. KNOX, Professor of Natural Science, Baker University.

In the soft sandstone on the banks of a creek about two and one-half miles southwest of Baldwin, are found Calamites in great numbers. The quarry is west of the Dr. Cowgill farm, at the crossing of the main road from Prairie City, over a small branch of Tahwo Creek. The Calamites are found in greatest abundance and of best quality a little north of the bridge, on the west bank.

During the winter of 1873–4, while passing down this creek in search of specimens, I noticed some Calamites cropping out of the rock, and afterwards succeeded in securing a few fine ones, but did not work the quarry to any extent, as there was in our cabinet a fine lot of Calamites gathered from various other points about Baldwin. Some time last winter Prof. Mudge, accompanied by Mr. Joseph Savage of Lawrence, came to Baldwin, having heard of this quarry. Armed with a strong, sharp iron bar for splitting up the rock, we went there with some students to assist us, and in the course of three hours secured as many as fifty good specimens, some fifteen of them being "tips," of great beauty and perfection. Since then we have taken out and put in our cabinet about two hundred good specimens for preservation and exchange, while a great many more have been taken out for the State University and for different individuals. There are several other places about town at which Calamites are found, probably in the same layer of sandstone, but none yields specimens like this. Prof. Mudge thinks there is no other quarry equal to this one, in the west.

These Calamites represent the species *cannæformis*, and *transitionis*, and others which I have been unable to identify with my limited literature on this group of

fossils. They vary greatly in size, some being less than half an inch in diameter, while others are four or five inches. The longest continuous specimen is about twenty-eight inches. They exist in vast numbers in small areas, some small slabs of rock revealing them by the dozen. Of so-called "tips," the most valuable specimens, we have found three kinds. The most common is pyramidal in shape, three or four inches in diameter at the base, and six or eight inches in length, the apex or point being deflected. Another kind is small, less than an inch in diameter, with the point rounded, while the preceding one is sharp. The third, of which I have found but one specimen, is slender, sharp, wedge shaped, and with very fine striae. Lyell figures some of these tips, and comes to the conclusion that they are the roots of the Calamite instead of the top of the stalk. He and Dr. Dawson found, in Nova Scotia coalfields, these tips projecting downwards in position, thus showing their nature beyond question. He thinks, too, that they are the striated piths, instead of being the outside of the stem. He is borne out in these views by several able European geologists. In one or two of these specimens in our cabinet, I have found a mark that is not mentioned either by Lyell or Dana. It is a deep scar close to the joints, as large as the end of ones finger. They occur in vertical series at alternate joints, and one-quarter around the stem. Are they the marks of branches? Are the very small fossils only the branches of the main trees? The rarity of these large scars, suggest proof of Lyell's position, that the most of our Calamites are only casts of the piths.

In connection with this quarry and others about Baldwin, I have found a fossil as yet not identified, but which I surmise to be roots of Calamites, like underground stems or root-stalks. They are from half an inch in diameter to two inches, and I have secured some a foot long. They are not marked with striae lengthwise, but are decidedly rugose transversly, like roots of trees growing at present. There seem to be no marks of joints or branchings. In every instance of extensive Calamites, they are found, and only there.

Authors disagree in locating the place of Calamites in the vegetable kingdom. Most, however, among them Dana, place them in Lycopodiaceæ, the Equisetum, or gigantic "horsetail," the only representative now living being the scouring rush. Still there are many marks of their belonging to Gymnosperms. In connection with these Calamites near Baldwin, are found various leaves, flags, and some well defined casts of *Cordiates*. Also well preserved *Sigillaria*.

KANSAS MAMMALIA.

By PROF. M. V. B. KNOX, of Baker University

FELIDÆ.

1. *Felis concolor* Linn.—American Panther. A specimen taken about nine years ago at Valley Falls, by Mr. Whitman, and identified by him. Probably only a transient visitor. Now and then known as crossing different parts of the State.

2. *Lynx rufus* Raf.—Bay Lynx. Wild Cat.* Quite common in timber in all parts of the State.

CANIDÆ.

3. *Canis lupus* Aud. and Bach.—Gray or Timber Wolf.*—Not uncommon in all parts of the State. Many are taken on the plains every winter for their splendid fur that is used for muffling robes.

4. *C. latrans* Say.—Coyote. Prairie Wolf.* Very destructive to domestic fowls. This and *C. lupus* seem to be getting more common in older parts of the State.

5. *Vulpes fulvus* Desm.—Red Fox. Common in all parts of the State.

6. *V. velox* Say.—Kit Fox. Swift. Rare.

7. *V. Virginianus* Rich.—Gray Fox. Rarer than the Red Fox. One taken near Baldwin, November, 1874, by John Griffith.

BASSARIDÆ.

8. *Bassaris astuta* Licht.—Texas Civet Cat. Allen. Rare in western parts of the State.

MUSTELIDÆ.

9. *Mephitis mephitica* Shaw.—Common Skunk.* Frequent.

10. *M. bicolor* Gray.—Little Striped Skunk. Polecat.* More frequent than the common Skunk. A pest to farmers. Said, however, by Mr. Joseph Savage, of Lawrence, to enter the burrows of the Pouched Gopher, and to destroy them. Also, it is well established that they destroy rats about barns.

11. *Putorius noveboracensis* DeKay.—White Weasel.* Occasional. Winter coat does not always become white in this State.

12. *P. vison* Forster.—Common Mink. Frequent about the streams.

13. *P. nigrescens* Aud. and Bach.—Little Black Mink. Rare. Specimen reported in Baird, Report, p. 180, as taken by Lt. D. N. Couch, Fort Leavenworth.

14. *Lutra Canadensis* Sab.—Otter. Rare. Found in north parts of the State.

15. *Taxidea Americana* Schreb.—Badger.* Occasional.

URSIDÆ.

16. *Ursus Americanus* Pallas.—Black Bear. Occasional in timber in central parts of State.

PROCYONIDÆ.

17. *Procyon lotor* Linn.—Raccoon.* Common.

BOVIDÆ.

18. *Bison Americanus* Gm.—Buffalo. American Bison. Vast numbers roam over the western parts of the State, migrating northward in the spring and southward beyond the Arkansas river in the autumn. They are being slaughtered by the ten thousand annually, for their hides, meat, bones, and the sport of killing them. Should not legislation put a stop to this wholesale destruction?

EQUIDÆ.

19. *Equus caballus* Linn.—Wild Horse. Adventitious from Europe. Considerable herds are seen in the west part of the State, especially southward, along the Arkansas River region.

The manner in which these are captured by a man living near Osborn, is this: He goes to the region of the divide between the Platte and Arkansas rivers, where the wild horses seem inclined to spend the summer. With a team and extra saddle

* Specimens marked * in Baker University Cabinet.

horse, he starts a troop of wild horses, pursuing them, only walking his team, but never permitting the wild horses to stop for a moment. At night he does not camp till after dark, when he feeds his team well on substantial food brought with him, while the tired wild horses rest and wait till morning to feed. But by daylight he has his team well fed and rested, ready to start the hungry herd on its useless flight. By the fourth day the wild horses are worn, hungry and weak, when he takes his saddle horse, reserved for this time, and easily lassoes the wild ones, returning home with the rich results of his strange chase.

From reliable information gathered the past summer in the southwest, I find that the wild horse breeds in Kansas, thus entitling it to a place in our list of mammalia. Not unfrequently when crossing the plains in the early part of the season, the traveler's camp is approached by a troop of wild horses. In well established instances mares have been coaxed from the camp of the traveler, and taking to flight with their new wild lord, have joined his already considerable seraglio, and have been wholly lost, probably becoming veritable wild horses. Certain other domesticated animals at times show a decided inclination to take again to their wild habits.

CERVIDÆ.

20. *Cervus Canadensis* Erxl.—Elk. Quite common in the west parts of the State.

21. *C. macrotis* Say.—Mule Deer. Allen. "More or less common along the wooded portions of the streams, especially on the Smoky and the Paradise."

22. *C. Virginianus* Bodd.—Virginia Deer. Frequent in large bodies of timber in different parts of the State.

ANTILOCAPRIDÆ.

23. *Antilocapra Americana* Ord.—Pronghorn. Antelope. In great numbers on the western plains, in herds of ten or twenty. The young are easily tamed.

VESPERTILIONIDÆ.

24. *Lasiurus noreboracensis* Tomes.—Red Bat.* Occasional. Entering houses evenings for catching flies.

25. *L. cinereus* Allen.—Hoary Bat.* One taken in College building, Baldwin, 1874.

26. ——— ——— Bat.* Taken at Baldwin, 1874. Not yet determined.

SORICIDÆ.

27. *Blarina Carolinesis* Bach.—Shrew.* Rare.

MURIDÆ.

28. *Jaculus Hudsonius* Zimm.—Jumping Mouse. Baird. A specimen taken in the Baldwin City Nursery, of Mr. Plasket, and identified by Miss Amanda Plasket, of Cornell University, Iowa. Taken also at Lawrence, by Prof. Snow.

29. *Mus musculus* Linn.—Common Mouse.* Everywhere. An albino specimen was placed in our cabinet, April, 1872, by Miss Ella Deane. White stripe on the back and sides.

30. *M. decumanus* Pallas.—Brown Rat.* Ever attending man in his "Westward Ho."

31. *Hesperomys leucopus* var. *sonoriensis* Exrl.—White Footed Mouse. Allen. Found by him at Fort Hays.

32. *H. Michiganensis* Aud. and Bach.—Prairie Mouse. Not plenty.

* Specimens marked * in Baker University Cabinet.

33. *H. leucogaster* Maxim.—Missouri Mouse. Coues.

34. *H. palustris* Harlan.—Rice Field Mouse. Coues. Specimen identified by B.F. Goss, Neosho Falls.

35. *Arvicola riparia* var. *longipilis* Ord.—Meadow Mouse.* Rare. One sent to us by Esquire Rice, Black Jack, 1875. Taken at Lawrence by Prof. Snow.

36. *A. austerus* L. C.—Prairie Meadow Mouse. Coues.

36a. *A. austerus* var. *cutata* Cope. Coues.

37. *Ochetodon humilis* Aud. and Bach.—Harvest Mouse. Coues.

38. *Neotoma floridana* Ord.—Wood Rat.* Common along the streams of the middle and western parts of the State. They build nests by piling up sticks and pieces of bark, to the hight of two or three feet, often about the base of a tree or stump. In the middle of these piles they have a nest of dried grass and leaves.

39. ——— ——— Mouse.* Taken at Coal creek, 1873, by C. K. Jones. Not yet identified.

40. *Sunaptomys Cooperii*—Cooper's Lemming. Coues. Taken at Neosho Falls by Col. Goss.

41. *Fiber Zibethicus* Cuv.—Muskrat. Now and then found along streams.

TALPIDÆ.

42. *Scalops argentatus* Aud. and Bach.—Prairie Mole. Silver Mole.* Frequenting gardens and yards, damaging bulbs, etc.

GEOMYIDÆ.

43. *Geomys bursarius* Shaw.—Pouched Gopher.* A well known pest, marking his course across fields by a line of small piles of dirt. Destruction to hedges. Said to find a deadly enemy in the Little Striped Skunk.

44. *G. breviceps* Baird.—Short Headed Gopher. Taken by Dr. A. W. Hammond, at Fort Riley. Specimen in Smithsonian Institute. (Baird's Report, p. 378.)

45. *Dipodomys Ordii* Woodh.—Kangaroo Rat. Common in southwest parts of the State. Found at Sargent.

46. *D. Phillipii* Gray.—Kangaroo Rat. Taken at Osborn by Richard Foster. Specimen in Washburn College, Topeka.

47. *Perognathus fasciatus* Maxim.—Kangaroo Rat. Taken at Topeka, Kansas, and identified by E. A. Popenoe.

48. *Castor Canadensis* Kuhl.—Beaver. Common along most of the large streams. Getting scarce in the eastern parts of the State. Does much damage to timber along the streams. Seldom builds dams or huts in Kansas, but lives under overhanging banks and roots.

SCIURIDÆ.

49. *Sciurus ludovicianus* Custis.—Western Fox Squirrel.* Frequent in all heavy bodies of timber.

Of this squirrel I have secured three well marked varieties. The first is that commonly found, the back grizzled black, gray and rusty, the under parts yellowish red. The second variety is dusky. The back is reddish brown and black, the black predominating. The belly is dark rusty. The face, nose, and cheeks, are almost pure black. A heavy line of glossy black runs down the front side of all the legs. The fur is short, thick and fine. The third variety is black. A slight annu-

* Specimens marked * in Baker University Cabinet

lating with lighter of some of its fur, tinges it a little with rusty, but the general color is glossy black. Brownish beneath, but there almost black.

50. *S. Carolinensis* Gm.—Gray and Black Squirrel.* Less frequent than the Fox Squirrel. Both Gray and Black found in Kansas.

51. *Tamias striatus* Linn.—Chipmunk. Striped Squirrel.* Rare. Found along edges of timber beside grain fields.

52. *Spermophilus Franklinii* Sabine.—Gray Gopher.* Not common.

53. *S. tridecem-lineatus* Mitchell.—Striped Gopher. Prairie Squirrel.* Frequent.

54. *Pteromys volucella* Pallas.—Flying Squirrel.* Occasional in timber.

55. *Cynomys ludovicianus* Ord.—Prairie Dog.* Common in western parts of the State. Said by Prof. Mudge to be dying out very fast for some unknown reason.

56. *Arctomys monax* Linn.—Woodchuck. Ground Hog.* Rare.

HYSTRICIDÆ.

57. *Erethizon dorsatus* var. *epixanthus* Brandt.—Porcupine. Allen. Found sparingly in western parts of the State.

LEPORIDÆ.

58. *Lepus sylvaticus* Schreb.—Gray Rabbit.* Abundant. Destructive to orchards and gardens. Its flesh counted good eating.

59. *L. campestris* Bach.—Prairie Hare. Allen. Identified in the central parts of the State.

60. *L. callotis* Wagler.—Jackass-Rabbit.* Common in western parts of the State.

DIDELPHIDÆ.

61. *Didelphys Virginianus* Shaw.—Opossum.* Not rare in eastern parts of the State.

OBSERVATIONS ON THE HABITS OF CERTAIN LARVÆ.

By GEORGE F. GAUMER, Student in the University of Kansas.

During the past summer I have been considerably interested in the peculiar habits of several larvæ which I have undertaken to breed.

About the first of July I found some larvæ feeding upon the leaves of the Canadian Moonseed (*Menispermum Canadense*). These larvæ were then about one inch in length. The general color was glossy-black, thickly dotted all over with white. They had concealed themselves by cutting off the leaf-stems and fastening the stems and leaves all together with a silken web. Some of these leaves were green; others, and by far the larger proportion, were dead. I noticed that none of the green leaves were eaten, while the dead ones were ragged from having been eaten.

On the evening of the tenth of July, while collecting moths just after dark in a woody pasture, I chanced to pass through a thicket of Moonseed vines, where I

* Specimens marked * in Baker University Cabinet.

heard a noise as of rain falling on dry leaves. I soon found that the sound was caused by the larvæ biting the dead leaves.

Upon a closer examination I found that they were then feeding upon the dried leaves which they had previously prepared. The snapping sound thus made could be distinctly heard at some distance.

During the day the caterpillars reposed in a long tube composed of silk and dried leaves in the middle of the bunch.

Some of these larvæ were placed in a glass jar covered with mosquito bar. While there they grew slowly and cut the dried leaves into small pieces and devoured most of them; green leaves were introduced into the jar but remained untouched while green: when dry they were treated as the others.

It was now about the first of September and there was no change, so that I began to despair of obtaining any imagos from them, and did not look at them again until the first week of October, when they had all disappeared except two.

These two had spun a kind of coarse cocoon in the tube mentioned above, and were in this still unchanged. The body was somewhat shorter and thicker than when first taken.

Early in July I obtained from the tomato a very large larvæ of *Sphinx 5-maculata*, and placed it in the breeding cage for safe keeping until I should have time to write a description of it. When I came for the larva next morning, it had disappeared. I soon discovered where it went into the ground. I then began to remove the earth very carefully until I came upon what I supposed to be its cell; then digging down upon one side I next removed the upper part of the arch with a sharp knife.

The cell was then very little larger than the insect's body. The caterpillar was busily engaged working around the sides of its cell with its head. Every few moments it would contract the length of its body and in this way force out the soft earth. It then closed the opening which I had made in the cell. A few minutes later I again opened the cell and found it considerably enlarged, and the caterpillar carefully working around the sides with its jaws, and at the same time secreting a greenish fluid with which it was moistening the inner surface of its cell. The whole internal surface was now moist and smooth. It again closed the opening and I then left it for several days, when I again opened it and found the cell to be about three inches in length by one and a half in hight. The larva had already cast its skin. A few days later the chrysalis made its way through the wall of its cell, which had become very hard, almost like sun-dried brick, leaving a rather small circular opening in the end, and then working its way up through nine inches of soil before it reached the surface.

During the first three weeks of July, a creamy white caterpillar, with a very conspicuous dark green dorsal line, made its appearance upon the willow bushes along the banks of the Wakarusa. It was one and fifteen-sixteenths inches in length, and when alarmed or at rest was coiled up and hung to the edge of a leaf.

Some of these caterpillars were removed to the breeding cage where they grew rapidly, and soon afterward descended and excavated a small pit in which they made a very thick, strong, brown cocoon, nearly as tough as leather; it was very smooth inside, impervious to water and not easily indented. Some weeks later a cocoon was opened and the larva was still unchanged. In this condition the larva still remains, and will most probably so hibernate.

On the second of October I found a large Sphinx larva which was feeding upon the green ash. It was not very active, and ate but little for several days. Thinking that it might soon transform, I took it from the cage and began to describe it.

While in the act of measuring it a small white worm forced its way through the skin and stood upright upon the back of the caterpillar; soon, more began to come out, and in twenty minutes there were forty-two of these little parasitic grubs standing up at right angles to the body of the sphinx. In a few minutes these little worms began to double up so that head and tail came together. They then spun a fine, white, silk cocoon, and wove it about as wide as their own diameter; this they completed in two days. The Sphinx larva was alive and able to walk all this time, but did not eat. It died four days later.

Before the second brood of Maple Worms (*Anisota rubicunda*) had attained their growth, the supply of maple leaves was entirely exhausted, so that the worms were compelled to set out in search of food. At one place on the Wakarusa there is a grove of maples, some of which are very large; near this grove there is an open field which had been freshly plowed, and was slightly beaten down by the late summer rains.

While crossing this field one morning my attention was called to some maple worms crawling upon the ground at least fifteen rods from the nearest maple tree. After looking about for a few moments I found several specimens five rods or more beyond the first, making the remarkable distance of over twenty rods from the grove. Immense numbers of these larvæ must have perished on the Wakarusa and Coal creek bottoms from want of food. After the maple leaves were all gone I frequently found them feeding upon the leaves of the burr-oak.

A few days later, while at the old University building, I was surprised to find hundreds of these larvæ ascending Mount Oread from the maple groves in the corners of the lot, a distance of about eighteen rods from the old University. Nor did they stop when they had reached the summit of the hill, but many of them were trying to ascend the building. Curious to know what success they were having, I went to the top and there found three way-worn and sickly-looking worms; one of these was much contracted in length and soon afterward transformed into a chrysalis. These larvæ had attained a hight of more than one hundred and fifty feet above the place from which they started.

THE COTTONWOOD LEAF BEETLE.

(*Plagiodera scripta* Fabr.)

By W. OSBURN, Student in the University of Kansas.

Beetles are certainly remarkable for their various methods of obtaining sustenance in the larval state. Some live in the ground, feeding upon the roots of plants, some are wood-borers, and others feed upon decaying animal and vegetable matter; some live upon fruit, some are cannibals, devouring other insects, and others still feed upon the leaves of plants. The last method of obtaining sustenance is characteristic of the Chrysomelidæ family of beetles, to which belongs the above species. On July 22, 1875, we discovered *Plagiodera scripta* in the imago state, its eggs, the young, and full-grown larvæ, and the pupæ, all upon the same willow bush, so that we are enabled to give quite a full history of its habits and transformations.

The eggs are laid in batches, containing from ten to twenty eggs each, upon the

under sides of the leaves. When first hatched the larvæ are 0.12 of an inch in length, and black. After the first moult, the head is dark brown and the abdomen dusky. The food plants are the willow and cottonwood. Like the larvæ of the Colorado potato beetle, they are voracious feeders, a comparatively small number being sufficient to defoliate a tree of considerable size, and were they as numerous as the noted enemy to the potato vine, the damage done by them would be of no little moment. They eat into the side of the leaf, leaving the stem and veins naked. The first lot of beetles was raised from the willow, entering the pupa July 25th, and emerging July 30th.

On August 12th we captured two litters of larvæ upon the cottonwood, which had evidently just hatched, judging from the uneaten condition of the leaves upon which they were found. These entered the pupa August 20th, and came forth perfect beetles August 26th, thus making the time required for their total transformation about fifteen days, and establishing the certainty of at least two broods in a season. The most prominent peculiarity of the larva consists in the white fleshy organs which are thrust out from the tip of the abdomen and from the dark-brown tubercles on the sides of the body. What may be the exact use of these organs, especially of those upon the sides of the body, we are unable to tell. They find an analogy in the organs of the Ajax butterfly (*Papilio Ajax*), and the Asterias butterfly (*Papilio Asterias*). Like the organs of these butterflies, they give forth a strongly-scented secretion, and from this we might infer that they were a means of defense. One thing is certain, however, that the organ from the abdomen is made use of in pupation, for, this being extended, it is glued fast to the under side of some twig. The larva then only partially sheds its skin, one-fourth of the body remaining within the old skin, to which it is stuck fast. Thus, like the chrysalides of many butterflies, the pupæ remain suspended until the imagos come forth. The following are descriptions of three of the different stages of the insect:

EGG.— Length, 0.06 in. Diameter, 0.015 in. Elliptical in shape, and transparent green in color.

LARVA.— Length, 0.50 in. Circumference, 0.35 in. Head dark brown, circular, and much smaller than the body. General color of body light yellowish brown; feet dark brown, with an encircling band of light brown near the base; a convexo-concave patch of dark brown on the top of the first thoracic segment; a short tuberculous spine of dark brown on each side of the second and third thoracic segments, from which is projected a white, fleshy organ; a sub-dorsal row of dark brown spots, two spots to each segment in the second and third thoracic segments and one in the remaining segments, the spots of the two rows uniting in the eleventh, twelfth, and thirteenth segments and forming one oblong spot; below this, extending from the fifth segment to the last, is a row of dark brown tubercles, one tubercle to each segment; a lateral row of dark brown spots, one spot to each of the last nine segments, below which is a row of dark brown tubercles with one tubercle to each segment, except the second and third thoracic, which have two each; below the latter are two rows of dark brown spots, one spot to each segment, and finally a ventral row of dark brown elongated spots, one to each segment; abdomen provided with a white, viscid, fleshy organ, capable of being extruded.

PUPA.— Length, with the old skin of the larva, 0.50 in. True length, 0.31 in. General color, light brown; head, centre of thorax, and feet, dark brown.

THE ROCKY MOUNTAIN LOCUST.

(*Caloptenus spretus* Uhler.)

By PROF. F. H. SNOW.

Now that this scourge of vegetation has taken its departure, I desire to put upon record a few observations of the past two months.

Upon the sixth of April I discovered the first young locusts, upon the southern slope of Mount Oread, just beyond the limits of the city of Lawrence (latitude 38° 58′; longitude 95° 16′.) This elevation is the termination of the high prairie, forming one of the bluffs at the intersection of the valleys of the Kansas and Wakarusa rivers. When first observed, the young locusts in myriads were at rest upon the ground, some of them, however, feeding upon the leaves of the Indian Plantain (*Cacalia tuberosa*). They were very diminutive in size, and when disturbed by my walking among them, would hop only two or three inches high, looking very much like the grains of sand in rapid motion upon a vibrating acoustic plate. The hatching took place, I soon learned, not only on the slopes of the bluffs, but also in many spots in the "bottom" land, along roadsides and in fields of grass and grain. It was two weeks after the first hatching of the Mount Oread colony that Mr. W. Osburn caught one hundred and ninety individuals at one sweep of the hand.

Not until about the tenth of May did the young locusts begin to move from their hatching grounds and cause serious apprehension among the farmers for the safety of their crops. At this time combined and systematic effort in neighborhoods infested would have prevented a large portion of the destruction which ensued. By the twentieth of May it became evident that the various colonies of locusts would consume everything in the line of their march, and that their ravages would only be arrested by their departure upon gaining their wings. Even at this late day, however, many were able to save portions of their crops by the ditching process. By this method three determined farmers uniting their efforts, destroyed three hundred and twenty bushels of locusts by actual measurement in ten days' time. On the twenty-fifth of May the destroying armies were entering the city of Lawrence in all directions, and soon the desolation of gardens was almost complete. In two days beautiful lawns of blue-grass were transformed into desert spots, as if they had been subjected to the burning heats of a long and rainless summer. The leaves upon the trees, however, did not share the general destruction, as the wingless gluttons could easily be kept from ascending. One citizen, by persistent combat, successfully defended his beautiful grounds, destroying in six days some seventy bushels of locusts. About one-sixth of the city, between the principal (paved) business street and the river, was not reached by the invading hordes, as was the case with occasional farms in the surrounding country.

In order to obtain a more correct idea of the immense numbers of the locusts, on the first of June I caught upon my own premises, in a common butterfly-net, one-half bushel in one-half hour. One quart of these contained, by actual count, 4,000 individuals, or at the rate of 128,000 to the bushel. Five days later, June sixth, they had nearly doubled in size, as one quart contained only 2,100 specimens, these being full grown pupæ, just ready to pass into the "imago" form.

The first winged locust was seen on May thirtieth, its final transformation having been carefully watched in the University building. This gives a period of fifty-five days from the first appearance of the larva to the first observed "imago." The

winged locusts were first seen to rise, for final departure, on the third of June. By the twelfth of June, just two weeks from the time the last moult commenced, very few remained in the pupa condition. To-day, June fourteenth, nearly all have taken their flight from my garden, a few stragglers only remaining behind, generally unable to fly on account of imperfect wings.

The direction of their flight I have carefully noted. When the wind is strong they fly with the wind. If the wind is light they fly towards the northwest, by what appears to be a natural instinct. Thus on June seventh, with a southwest wind, moving, according to the University anemometer, at the rate of three miles an hour, the locusts were flying in vast numbers in a direction a little to the north of west, *nearly in the face of the wind.* On June twelfth, also, with a northeast wind blowing at the rate of four miles an hour, they were flying in greater numbers than ever before in a northwest course, *at right angles to the direction of the wind.* It is therefore my belief that the natural instinct of the winged locusts of the spring hatching is to move towards the northwest, and though they may be temporarily delayed by contrary gales, that they will sooner or later, with ranks decimated by weakened constitutions and by the ravages of birds and parasites, arrive at their natural home in the mountains. It is even possible that none may live to reach the original home of the species. I do not consider the Eastern States to be in any danger from a locust invasion. I have observed hundreds of winged locusts fall to the ground during flight, either already dead or soon dying. These, upon examination, have generally proved to contain no parasites, and I judge that their death was in consequence of impaired strength, this second generation raised in an unnatural climate not equalling in vitality the first generation and succumbing to the fatigue consequent upon extended flight.

In regard to the natural enemies of the locust, I have observed a little external red parasite under the rudimentary wings of the pupa, and sometimes upon the body and secondary wings of the imago. These are mites, of the same class of insects as the spiders, and are not *eggs* as some have supposed. They occur in numbers from one to a dozen upon a single locust, and suck the life-fluid from its body, Placing about one quart of the locusts by themselves in a breeding cage, June fifth, I bred from them, within two weeks, some twenty specimens of parasitic flies belonging to three different species. One of these was the common Flesh-fly (*Sarcophaga carnaria*), and the other two were of the genus *Tachina*, the species not yet determined. I have also discovered several specimens of the Spined Soldier-bug (*Arma spinosa*), each with its jointed beak inserted in a locust of more than double its own size, and not leaving its victim until life was entirely extinguished. The large fly commonly termed the Bee-killer (*Asilus*), has been seen destroying the locusts in considerable numbers. Spiders have aided in the work of exterminating the pest. Finally, I am able to offer scientific proof that at least seven species of birds feed upon the locusts, having found them in the gizzards of the Red-headed Woodpecker (*Melanerpes erythrocephalus*), Yellow-billed Cuckoo (*Coccyzus Americanus*), Cat-bird (*Mimus Carolinensis*), Red-eyed Vireo (*Vireo olivaceus*), Great-crested Flycatcher (*Myiarchus crinitus*), Crow Blackbird (*Quiscalus versicolor*), and Blue-bird (*Sialia sialis*).

The preceding account being based entirely upon personal observations of the writer at his own home, it must not be inferred that the ravages of the locusts have been equally severe in the whole State of Kansas. The destruction by these pests for the year 1875 has been confined to a narrow strip on the eastern border of the State. Kansas, as a whole, never had finer promise of bountiful crops than at the

present time, and a second planting will undoubtedly repair the damage in the desolated district. The departure of the locusts is taking place more than two weeks earlier than at the time of the first visitation, eight years ago.

LAWRENCE, KANSAS, June 20, 1875.

LARVA AND CHRYSALIS OF THE SAGE SPHINX.

Sphinx lugens Walker (*eremitoides* Strecker).

By PROF. F. H. SNOW, of the University of Kansas.

During the last days of September, 1873, large numbers of caterpillars not observed in former years, were found feeding upon the leaves of the two species of wild sage which grow abundantly in this region. Some of these being transferred to breeding cages, they in a few days entered the ground, and in May and June, 1874, I obtained from them the moth whose name appears at the head of this article. As the larva and chrysalis of this species have been hitherto unknown, I append the following descriptions:

LARVA: Length, 3½ inches; diameter of central segments, .56 inch. Head greenish brown with a conspicuous white stripe on each lateral margin of the front, separating it from the brownish black sides of the head. The first three segments are of a light smoky green, thickly sprinkled with minute white dots, and having a dorsal brownish-black longitudinal band which tapers to a point at the front of the second segment, and enlarges to half its former breadth upon the rear of the first segment, tapering again to a narrow white-centered line at the front of this segment. This dorsal band is bordered with white on each side and is not continued beyond the third segment. Color of the remaining segments (except the last which is smoky brown with white dots), light green both above and below, with eight transverse rows of minute brownish-black, incomplete annuli upon each segment. Each of these segments has an oblique white lateral stripe extending from the anterior margin of the stigma to nearly the middle of the adjoining segment, becoming obsolete as it reaches the dorsal surface, except the seventh and last stripe, which remains distinct until it reaches the caudal horn. Each of these white stripes has an obscure blackish border on its upper margin. The white stripe is faintly indicated on the anal segment which is inferiorly margined with white. Caudal horn deep brownish black, .37 inch in length. Stigmata yellowish brown encircled with black, bounded inferiorly with an obscure white line. True legs of a smoky color with silvery spots on the inner surface; prop-legs deep smoky brown, lighter on the inside and with the clasping edges black.

Some of the larvæ have the smoky brown markings very obscurely indicated, the prevailing color being pale green.

FOOD PLANTS: *Salvia trichostemmoides* Pursh, and *Salvia Pitcheri* Torrey.

The larva becomes full grown from the first to the fifteenth of October, and forms its chrysalis in the ground at the depth of five to six inches.

CHRYSALIS: Length 2.30 inch; breadth 0.60 inch; color reddish brown, darker at the anal extremity, upon the upper surface and around the stigmata; an olive tinge upon the breast. The tongue case is 1.12 inch long from the end of the loop to the

tip, and is strongly arched, being separated from the body 0.22 inch near its base and just touching the breast at its tip.

The imago appears from May fifteenth to June fifteenth.

LAWRENCE, KAN., Oct. 1, 1875.

CATALOGUE OF THE LEPIDOPTERA OF EASTERN KANSAS.

By PROF. F. H. SNOW, of the University of Kansas.

The following preliminary catalogue of the butterflies and moths of Kansas includes no species with which the writer has not made a personal acquaintance. With the exception of twenty of the moths, all the species are represented in the collections of the University of Kansas, having been taken within five miles of Lawrence, in Douglas county, thirty miles west of the Missouri river In order to make this list of some practical value to our fruit-growers, farmers, and students of natural history, brief descriptions and notes are given, and the food-plant of each species is stated when known. From the notes it will be seen that this order of insects is not composed of mere harmless creatures, without claim to attention and study except for their marvelous beauty of ornamentation. Each species has its peculiar food-plant, upon which it feeds with great voracity during the entire period of its existence as a "larva" or caterpillar. In the "imago," or perfect condition, the Lepidoptera feed chiefly upon the nectar of flowers, doubtless performing an important part in their fertilization, and are entirely harmless except as depositing eggs for new broods of caterpillars. The question whether a given species is injurious to mankind will depend entirely upon the value of its food-plant. In the majority of cases, by "chasing a butterfly" and destroying it, one would render a service to humanity in the prevention of injury to some valuable crop.

Substantial aid in making collections has been rendered by students of the University, among whom special mention should be made of Mr. Geo. F. Gaumer. Thanks are due to Mr. W. H. Edwards, of Coalburgh, West Virginia, for valuable aid in the determination of the butterflies, which include the first eight families. Other acknowledgements will be made in their appropriate places.

FAMILY I.

PAPILIONIDÆ; SWALLOW-TAILS.

This family, named from the unusual length of the tips of the hind pair of wings, is represented by six species, all belonging to the genus

PAPILIO Linnæus.

(Each species with a crimson or orange spot on the inner margin of the hind wings.)

1. *Philenor* Linn.— Black, with bluish-green metallic lustre upon the hind wings. Expands 3½ to 4¼ inches. Comparatively rare; the caterpillar feeds on the Virginia snakeroot and two other species of the genus *Aristolochia*. The fact that these plants are not indigenous in this locality, and are but rarely cultivated in gardens, accounts for the scarcity of this butterfly.

2. *Asterias* Drury.—Black, with two rows of yellow spots along the margin of each wing; expands 3½ to 4½ inches. Abundant; the caterpillar, which is greenish-yellow with black stripes and spots, feeds voraciously upon the foliage of parsnip, carrot, celery, and other umbelliferous plants.

3. *Troilus* Linn.—Very rare; only two specimens taken. Its chief food-plant, sassafras, has not yet been discovered in this vicinity; it also feeds upon lilac and the spice bush.

4. *Turnus* Linn.—Yellow, with broad, black margins and transverse black bands; expands 3½ to 4¾ inches; quite common. Its larva feeds upon the foliage of the apple, wild plum, wild cherry, white ash, tulip tree and wild thorn.

4a. *Glaucus* Linn.—A black dimorphic female form of *Turnus*, common here. But one yellow female has yet been taken.

5. *Cresphontes* Cramer.—Black, with two broad bands of yellow spots, one of which crosses the base of the hind wings; expands 4½ to 5¼ inches. Common in 1873 and 1874; rare in 1871, 1872 and 1875; feeds upon the prickly ash and the hop-tree in this region—upon the orange tree in the Southern States.

6. *Ajax* Linn.—Pale black, with bluish-white bands and spots; expands 2½ to 3¼ inches. Abundant; feeds on the pawpaw. There are three varieties:

a. Var. *Marcellus* Bois. with tails an inch long.

b. Var. *Walshii* Edwards, of smaller size and with tails only half an inch long. Of this variety the sub-variety *Abbotii* Edwards also occurs.

c. Var. *Telamonides* Felder, intermediate in size between a. and b.

FAMILY II.

PIERIDÆ; WHITE OR SULPHUR BUTTERFLIES.

PIERIS Schrank.

7. *protodice* Bois.-Lec.—Southern Cabbage Butterfly. White, with pale black spots; the male with more white than black, the female with more black than white; expands two inches; becoming more common every year. This species is very destructive to cabbages; in the neighborhood of our chief towns it is often impossible to find a perfect head in cabbage fields of large size, the loss amounting annually to thousands of dollars.

8. *vernalis* Edwards.—Not uncommon in April; similar in appearance to *protodice*, but smaller, and with dark lines along the veins of the secondaries underneath. Food-plant unknown, being doubtless some plant of the mustard family (*Cruciferæ*).

ANTHOCARIS Boisduval.

9. *Olympia* Edwards.—White, with dusky markings and delicate violet reflections; expands fully 1½ inches. Exceedingly rare. Food-plant unknown. This species is represented in but two or three collections in the United States.

NATHALIS Boisduval.

10. *Iole* Bois., var. *Irene* Fitch.—Abundant. The smallest species in this family; expands one inch; sulphur-yellow with black markings.

CALLIDRYAS Boisduval.

11. *Eubule* Linn.—Rare. Bright sulphur-yellow; expands 3 inches.

COLIAS Fabricius.

12. *caesonia* Godart.—Sulphur-yellow, with broad black irregular margins and pink fringes; expands 2½ to 2¾ inches; abundant; feeds upon clover.

13. *Eurytheme* Bois.—Orange-yellow, with black margins; expands 2 to 2½ inches; abundant.

14. *Philodice* Godart.—Sulphur-yellow, with black margins; expands 2¼ to 2⅝ inches; common; two-brooded; feeds upon clover and peas.

TERIAS Swainson.

15. *Nicippe* Cramer.—Deep orange-yellow with black margins; expands two inches. Common; food-plants—clover and cassia.

16. *Mexicana* Bois.—Light sulphur-yellow, with irregular black margins; expands 1½ to 1¾ inches. Not seen in former years, but appearing in abundance during the first week in November, 1875.

17. *lisa* Bois.-Lec.—Sulphur-yellow with black margins; expands 1⅜ to 1½ inches. Common; feeds upon the "partridge pea," (*Cassia Chamæcrista.*)

FAMILY III.

DANAIDÆ.

DANAIS Latreille.

18. *Archippus* Fabr.—The Archippus Butterfly. Tawny-yellow, with black and white markings; expands 4 inches; very abundant; sometimes appears in vast flocks in spring, having survived the winter in the "imago" or perfect state. The great abundance of this species may be accounted for by the fact that it has few enemies. The odor and taste of the caterpillar are so offensive that no bird will touch it. Fortunately it feeds upon milkweed, and is harmless.

FAMILY IV.

NYMPHALIDÆ.

EUPTOIETA Doubleday.

19. *Claudia* Cramer.—Pale tawny, with blackish lines; expands 2⅝ inches. Abundant; feeds upon violet, passion-vine, May-apple and purslane.

ARGYNNIS Fabricius.

20. *Idalia* Drury.—Tawny and black with white spots; expands 3⅝ to 4⅛ inches. Common; food-plant wild violet.

21. *Cybele* Fabr.—Tawny, with black markings; many silvery spots underneath; expands 3¼ to 3¾ inches. Common; feeds upon wild violet.

22. *Aphrodite* Fabr.—Like the preceding, but darker underneath; very rare, only one specimen taken; feeds upon violets.

MELITÆA Fabricius.

23. *phaeton* Drury.—A single specimen. Feeds upon honeysuckle and *Chelone.*

PHYCIODES Hubner.

24. *Nycteis* Doubl.—Common; feeds upon wild sunflower and *Actinomeris.*

25. *Ismeria* Bois.-Lec. (*Carlota* Reakirt.) Common; feeds upon wild sunflower.

26. *Tharos* Drury.—Abundant; feeds upon the various species of asters, as recently discovered by Mr. T. L. Mead, of New York.

27. *Phaon* Edwards.—Rare; not before found so far north.

GRAPTA Doubleday.

28. *interrogationis* Fabr.—Semicolon Butterfly. So called from the two silver spots beneath each hind wing. Common. Color fulvous with black spots and a narrow purple-gray margin; expands 2½ to 2¾ inches. Feeds upon elm, basswood, hackberry, nettle and the hop-vine, often cutting off the entire produce of the latter. Two varieties occur in about equal numbers:

a. Var. *umbrosa* Lintner; markings of hind wings obscured.

b. Var. *Fabricii* Edwards; markings of hind wings distinct.

These two forms have been bred from the same set of eggs by Mr. W. H. Edwards of Va.

29. *comma* Harris.—The Comma Butterfly. With a single curved silver spot under each hind wing; expands 2⅛ to 2⅓ inches; not common; feeds upon elm, nettle and the hop vine. As in the preceding species, two varieties occur, both bred from the same set of eggs, by Mr. Edwards.

a. Var. *Harrisii* Edwards; distinctly marked on hind wings.

b. Var. *Dryas* Edwards; hind wings obscure.

VANESSA Fabricius.

30. *Antiopa* Linn.—The Mourning Cloak. Brownish black, with yellow margins preceded by a row of blue spots; expands 3⅛ to 3½ inches. Not common; feeds on the willow, poplar, elm and hop; is often very destructive elsewhere.

PYRAMEIS Hubner.

31. *Huntera* Fab.—Hunter's Butterfly. Expands 2 to 2¼ inches; has two eye-spots under each hind wing; common; feeds upon thistle, sunflower, and other wild, coarse plants.

32. *cardui* Linn.—The Thistle Butterfly. Expands 2½ to 2¾ inches; has five eye-spots under each hind wing. Abundant; feeds upon thistles, sunflowers, hollyhock, burdocks, etc.

33. *Atalanta* Linn.—Brownish black with red band across front wings and red margin upon hind wings; expands 2¼ to 2⅝ inches. Common; the caterpillar feeds upon nettles, and has a peculiar protection from the poisonous prickles of its food plant in the longer prickles with which its own body is covered; also feeds upon the hop.

JUNONIA Hubner.

34. *Lavinia* Cramer.—Brown, with whitish band enclosing a large eye-spot upon each front wing; two eye-spots upon each hind wing; expands 2 to 2¼ inches; feeds upon plantain and toad-flax; common.

LIMENITIS Fabricius.

35. *Ursula* Fabr.—Black, with a bluish tinge which deepens upon the hind wings, expands 3 to 3½ inches. Not common; feeds on the gooseberry, apple, quince, plum, oak, hornbeam, hawthorn, willow and wild cherry.

36. *misippus* Fabr.—Similar in color to the Archippus butterfly, but with a narrow black band across the hind wings; expands 3 to 3⅝ inches. Common; feeds on the cottonwood, apple, oak, poplar, plum and willow. This species and the preceding are remarkable among butterflies for hibernating in the caterpillar state. The marked resemblance between this species and No. 18, furnishes an illustration of so-called "protective mimicry."

APATURA Fabricius.

37. *celtis* Bois.-Lec.—Grayish-brown, with white and black spots; eight eye-spots under each hind wing (one double); expands 2 inches. Common; feeds upon the hackberry.

38. *clyton* Bois.-Lec.—Tawny brown; seven eye-spots under each hind wing; expands 2 to 2¾ inches. Rare; feeds upon the hackberry.

PAPHIA Westwood.

39. *glycerium* Doubl.—Copper red; expands 2⅝ to 3 inches. Common; feeds upon the two species of goatweed found in this region (*Croton capitatus* and *C. monanthogynus*). The two sexes differ so much in coloration as to be easily mistaken for distinct species. This species is double brooded and hibernates in the imago condition.

FAMILY V.

LIBYTHEIDÆ.

LIBYTHEA Fabricius.

40. *Bachmanii* Kirtland.—Snout butterfly; brownish-black with white and tawny markings; palpi elongated, forming a conspicuous "snout;" rare formerly, but common in 1875.

FAMILY VI.

SATYRIDÆ.

The members of this family are grayish to blackish brown in color and have eye-spots both above and below.

EUPTYCHIA Hubner.

41. *eurytris* Fabr.—Rare; has two eye-spots upon each wing; expands 1½ inches; feeds upon grasses.

SATYRUS Westwood.

42. *Alope* Fabr.—Has a yellow patch upon each front wing enclosing two brown spots; expands 2⅛ to 2¾ inches. Common; feeds upon grasses.

43. *Nephele* Kirby.—Of a darker brown color. Common; feeds upon grasses; possibly a variety of the last.

LETHE Hubner.

44. *Portlandia*.—Not common; feeds upon grasses; expands 2⅛ to 2⅜ inches.

FAMILY VII.

LYCAENIDÆ; AZURE-BLUE AND COPPER BUTTERFLIES.

THECLA Fabricius.

45. *humuli* Harr.—Hop-vine Thecla. Dark blue-gray, with small orange spot and short tails upon tips of hind wings; expands 1 to 1⅛ inches. Common; feeds upon the heads of hops.

46. *calanus* Hubner.—Rare; feeds upon wild thorn (*Crataegus*).

47. *strigosa* Harris.—Rare.

48. *Mopsus* Hubner.—Rare; feeds upon thoroughwort (*Eupatorium*).

49. *Irus* Godart.—Rare; a pair taken in April, 1875.

FENISECA Grote.

50. *Tarquinius* Fabr., Var. *Porsenna* Scudder.—Exceedingly rare; a single specimen was taken by Geo. F. Gaumer in July, 1873.

CHRYSOPHANUS Hubner.

51. *Hyllus* Cramer.—Rare; food plant unknown.

52. *Dione* Scudder.—Not uncommon in 1875.

LYCÆNA Fabr.

53. *comyntas* Harr.—Abundant; feeds upon bush-clover (*Lespedeza* and *Desmodium*.

54. *isola* Reakirt.—Common.

55. *pseudargiolus* Bois.-Lec.—Common; bred by Mr. W. H. Edwards from *Actinomeris*.

FAMILY VIII.

HESPERIDÆ; SKIPPER BUTTERFLIES.

The members of this family have hooked antennæ; except *Nisoniades*, they feed upon grasses; one or two species also have other food-plants.

EPARGYREUS Hubner

56. *tityrus* Fabr.—Brown, with yellowish tinge; an interrupted yellowish band across each front wing, and a large satin-white spot beneath each hind wing; ex-

pands 1¾ to 2⅛ inches. Common; feeds upon the common locust tree (*Robinia pseudacacia*), and rose-acacia (*Robinia hispida*).

THORYBES Scudder.

57. *bathyllus* Abb.-Sm.—Abundant.

58. *Pylades* Scudder. Rare.

NISONIADES Hubner.

59. *juvenalis* Fab.—Common. Feeds upon oak and English filbert

60. *Martialis* Scudder.—Common.

61. *Brizo* Bois.—Rare.

62. *Horatius* Scudder.—Not uncommon ; a near ally of *juvenalis*, perhaps only a variety of that species.

PHOLISORA Scudder.

63. *catullus* Fabr.—Abundant; feeds upon pigweed.

64. *Hayhurstii* Edwards.—Rare; only three specimens taken.

HESPERIA Fabricius.

65. *tessellata* Scudder.—Gray-black with many small rectangular white spots; expands 1¼ to 1½ inches. Abundant.

ANCYLOXYPHA Felder.

66. *numitor* Fabr.— Not common; this and *catullus* are the smallest species in this family, expanding only one inch.

ATRYTONE Scudder.

67. *Iowa* Scudder.— Common.

68. *Delaware* Edwards.— Rare; one specimen taken by G. F. Gaumer.

69. *Kumskaka* Scudder Mss.— Rare; two specimens taken.

70. *Hobomok* Harris.— Rare.

EUTHYMUS Scudder.

71. *phylæus* Drury.— Rare in former years; common in 1875.

ATALOPEDES Scudder.

72. *Huron* Edwards.— Abundant.

ANTHOMASTER Scudder.

73. *Leonardus* Harris.— Rare.

POLITES Scudder.

74. *Peckius* Kirby.— Rare.

LIMOCHORES Scudder

75. *cernes* Bois.-Lec.— Common.

EUPHYES Scudder.

76. *Metacomet* Harris.— Rare.

77. *verna* Edwards.— Rare.

FAMILY IX.

SPHINGIDÆ; HAWK MOTHS.

The members of this family have been termed Crepuscular Lepidoptera to distinguish them from the diurnal and the Nocturnal Lepidoptera. They fly about flowers, chiefly at dusk, and in their movements bear no little resemblance to humming-birds. In the arrangement of species I have followed the monograph of Dr. Brackenridge Clemens. Twenty-seven species are known to occur in Kansas, twenty-three of which have been taken at Lawrence; the four remaining species were taken at Leavenworth and Tonganoxie, by Dr. W. B. Carpenter and Mr. T. B. Ashton.

SESIA Fabr. CLEAR-WINGED SPHINGES.

78. *axillaris* Grote.— Wings transparent except on margins; expands 1½ to 1⅞ inches; common.

79. *Thysbe* Fabr.—Colors olive-green and rich brown; wings transparent in centre; expands 2¼ inches; rare, only one specimen taken.

THYREUS Swainson.

80. *Abbotii* Swainson.—The Abbot Sphinx. Brown, basal half of hind wings yellow; expands 2½ to 3 inches. Rare; feeds upon both wild and cultivated grape, and upon the woodbine.

81. *Nessus* Cramer.—Brown, with two narrow transverse bands upon the abdomen. Rare.

DEIDAMIA Clemens.

82. *inscripta* Harris.—Grayish-brown; expands 1⅞ to 2¼ inches. Rare. Feeds upon sour-wood.

DEILEPHILA Ochsenheimer.

83. *lineata* Fabr.—White-lined Morning Sphinx. A whitish band from base to tip of each front wing; a broad red band across each hind wing; expands 3½ inches; feeds upon purslane and turnip; when in confinement will eat apple leaves. This species flies by day, and is very abundant.

DARAPSA Walker.

84. *Chœrilus* Cramer.—Reddish-brown, with fawn color upon the front wings; expands 3¼ inches; said to feed upon *Azalea*, a plant not found in Kansas. Rare, only one specimen.

85. *Myron* Cramer.—Front wings pale green with a darker band of same color; hind wings rust-red; expands 2¼ to 2½ inches. Very destructive to the foliage of the grape, sometimes also detaching clusters of the fruit. Abundant. Mr. Riley has named the larva the "Hog-caterpillar of the vine."

CHŒROCAMPA Duponchel.

86. *Tersa* Linn.—Front wings greenish-brown; hind wings black with marginal row of yellow spots; expands 2¾ to 3 inches. Rare, only one taken.

PHILAMPELUS Harris.

87. *Satellitia* Linn (*Pandorus* Hubner).—The Satellite Sphinx. Variegated with light green and olive; a light reddish patch at the inner angle of the hind wings; expands 4 to 4½ inches; feeds upon the grape vine and the woodbine. Rare.

88. *Achemon* Drury.—Fawn color with three dark-brown patches upon each front wing; hind wings deep pink with broad brownish margin; expands 3¼ to 4 inches; feeds upon the grape vine. Not common.

89. *labruscæ* Linn.—Front wings green; hind wings blue with black transverse bands; expands 4½ inches. Very rare, one specimen taken at Leavenworth by Dr. W. B. Carpenter.

MACROSILA Walker.

90. *cingulata* Linn.—Gray, with bases of hind wings and five spots upon each side of the abdomen deep rose-red; expands 4⅝ inches; feeds upon the sweet potato. Rare.

91. *Carolina* Linn.—The Tobacco-worm Moth. Dark gray with five orange spots on each side of the abdomen, and obscure wavy black lines across the hind wings; expands 4 to 5⅛ inches; feeds upon the tobacco plant; also upon the tomato. Common.

92. *quinquemaculata* Stephens.—The Potato-worm Moth. Almost identical in appearance with the last species, but with the markings of the hind wings distinct; expands 5 to 5½ inches; feeds upon potato and tomato. Common.

SPHINX Linn.

93. *eremitus* Hubner (*sordida* Harr.)—Dark gray with two whitish bands upon the hind wings; expands 2⅝ to 2¾ inches. Not common.

94. *lugens* Walker (*eremitoides* Strecker).—The Sage Sphinx. Of a lighter gray than the last species; expands 2⅞ to 3¾ inches; common; feeds upon our two species of wild sage (*Salvia trichostemmoides* Pursh. and *S. Pitcheri* Torrey).

95. *drupiferarum* Abb. and Sm.—Front wings blackish-brown, with basal portion of anterior margin and band along outer margin, whitish; hind wings whitish, with two black bands; expands 4 to 4¾ inches; feeds upon the plum and the hackberry; rare.

ANCERYX Walker.

96. *Ello* Linn.—Gray except hind wings which are rust red with broad blackish terminal margins; expands 3½ inches; rare, two specimens taken by Dr. Carpenter, at Leavenworth.

DOLBA Walker.

97. *hylæus* Drury.—Dark brown with white and black markings; two blackish bands across hind wings; expands 2¼ inches; not common; taken at Leavenworth by Dr. Carpenter and at Tonganoxie by T. B. Ashton. Feeds upon papaw.

CERATOMIA Harris.

98. *quadricornis* Hubner (*Amyntor*).—The Elm Sphinx. Dull brown varied with black; expands 4 to 4¾ inches; feeds upon the elm; rare.

99. *repentinus* Clemens (*undulosa* Walker; *Brontes* Drury).—The Ash Sphinx. Pale ash color, with three narrow wavy black bands crossing hind wings; expands 4 inches; feeds upon the ash and lilac; not common.

SMERINTHUS Latr.

100. *Myops* Abbot and Smith.—Front wings chocolate brown, hind wings pale yellow; expands 2½ inches; feeds upon the wild cherry. Rare, taken by T. B Ashton at Tonganoxie.

101. *excæcatus* Abb. and Smith.—The Blind Smerinthus. Fawn color with brown patches; hind wings rose red in the center with a black, blue-pupiled eye-spot; expands 2½ to 3⅜ inches; feeds upon apple, wild rose and maple; not uncommon.

102. *modesta* Harris.—The front wings are pale gray with a darker broad central olive-brown band; hind wings purplish red with bluish spot at inner angle; expands 4½ to 5 inches; rare; feeds upon the Lombardy poplar, and other poplars.

103. *geminatus* Say.—Front wings gray with rosy tinge and dark brown markings; hind wings rose red with a black eye-spot having two blue pupils; expands 2¼ to 3 inches; rare; feeds upon willow.

104. *juglandis* Abb. and Sm.—Pale gray or fawn color with darker bands and spots; hind wings with a light central band margined with dark lines; expands 2¼ to 3 inches; common; feeds upon walnut, iron-wood and hickory.

FAMILY X.

ÆGERIADÆ: THE ÆGERIANS.

ÆGERIA Fabricius.

105. *exitiosa* Say.—The Peach-tree Borer. The greatest enemy of the peach-tree. The male moth has all the wings transparent and expands one inch; the female has the front wings bluish black, the hind wings transparent and an orange band across the middle of the abdomen. The larva bores in the outer wood of the trunk of the tree near the ground, sometimes descending into the root. This species also occasionally attacks plum and cherry trees. Abundant, often destroying whole orchards.

106. *cucurbitæ* Harris.—The Squash-vine Borer. Similar in size and appearance to the preceding, but with nearly the entire abdomen and the hind legs of a deep orange color. The larva bores into the stem of the squash, and other vines of the

melon family, near the root, and causes them to suddenly wilt and die. Five specimens are in the cabinet, taken by G. F. Gaumer.

107. *tipuliformis* Linn.—The Currant Borer. Bluish black; wings transparent except the black margins; three narrow yellow rings on abdomen (four in the male); expands ¾ inch. Very destructive to currant bushes, boring in the pith; common.

108. *Ægeria* sp.—An undetermined species; taken by Mr. Gaumer upon the flowers of the button-bush(*Cephalanthus*). Six narrow yellow bands upon the abdomen; expands .80 inch. Quite common.

FAMILY XI.

ZYGÆNIDÆ.

ALYPIA Hubner.

109. *octomaculata* Fabr.—The Eight-spotted Forester. Black with two pale yellow spots on each front wing and two white spots on each hind wind; expands 1⅜ to 1⅝ inches. Becoming common; very destructive to vineyards in Douglas county in 1875, in some cases completely defoliating the vines and cutting off the crop.

PSYCHOMORPHA Harris.

110. *epimenis* Drury.—The grape-vine Epimenis. Black, a white spot on each front wing; expands .9 to 1.1 inch; feeds upon the tender leaves of the grape in early spring; not yet so common and destructive as the last species.

EUDRYAS Boisduval.

111. *grata* Fab.—The Beautiful Wood-nymph. Front wings white, hind wings yellow, all the wings with dark red margins. Feeds upon the grape vine; rare, only two specimens taken. The larvæ of this and the two preceding species have been called by Mr. Riley the "Blue Caterpillars of the vine"; they are very similar in appearance, being of a bluish color with many narrow transverse black stripes.

GLAUCOPIS Latreille.

112. *fulvicollis* Hubner.—Smoky black, with orange head and collar; hind wings partly transparent; expands 1¼ inches; common.

FAMILY XII.

BOMBYCIDÆ; SILK-WORM FAMILY.

The seventy-five species in this family are arranged according to Dr. A. S. Packard's Synopsis.

HYPOPREPIA Hubner.

113. *fucosa* Hubner.—Deep pink, with smoky markings; expands 0.9 to 1.1 inches; not common.

CRAMBIDIA Packard.

114. *pallida* Packard.—Uniform drab; expands ¾ inch; not common.

EUSTIXIS Hubner.

115. *pupula* Hubner.—White, with black dots upon front wings; expands 0.6 inch; one specimen.

EUPHANESSA Packard.

116. *mendica* Walker.—Wings nearly transparent, but with a yellowish tinge; smoky spots upon the front wings; expands 1 to 1¼ inches; common in the Wakarusa woods.

CROCOTA Hubner.

117. *Crocota* sp.—An undetermined species; of a uniform dull red; expands 1 inch; common.

UTETHEISA Hubner.

118. *bella* Linn.—Front wings deep yellow, with five or six white bands enclosing black spots; hind wings bright scarlet with black margins; expands 1½ inches; common; feeds upon the unripe seeds of the "rattle box"(*Crotalaria*).

CALLIMORPHA Latreille.

119. *interrupto-marginata* Beauv.—Rare; a single specimen taken at Leavenworth by Dr. Carpenter.

120. *Lecontei* Boisd. (*militaris* Harr).—The Soldier Moth. White, with front wings margined and crossed with brown bands; expands two inches; common; bred from the "false gromwell" (*Onosmodium*).

121. *vestalis* Packard.—White, with front margins of front wings and the legs yellowish; expands 2 inches; rare. Mr. Riley considers this species to be identical with *C. fulvicosta* Clemens, the larva of which feeds upon young peach leaves in the spring, and is called by him the Blue Spangled Peach-worm.

ARCTIA Schk.

122. *virgo* Linn.—Virgin Tiger Moth. Front wings black, with many interlacing stripes of flesh color; hind wings vermilion, with black spots along the margin and in the centre; expands 2⅛ to 2½ inches; rare.

123. *parthenice* Kirby (*Saundersii* Grote).—Similar to the preceding, but smaller, also with the black of front wings more restricted, and without black spots in the centre of the hind wings; expands 1.65 inches; abundant; bred by Mr. Gaumer from iron-weed (*Vernonia*); also by Mr. Saunders, of Canada, from lambs-quarter (*Chenopodium*).

124. *phalerata* Harris.—The Harnessed Tiger Moth. Stripes on front wings pale yellow, and fewer than in the preceding; hind wings yellow, tinged with red, with black margins sometimes entire and sometimes broken into spots; expands 1½ inches. Not uncommon.

125. *Phylira* Drury.—Similar to *virgo*, but smaller, and without black spots in centre of hind wings; expands 1½ to 1¾ inches. Not common.

126. *decorata* Saunders (*Nais* Drury).—Similar to *phalerata*, but with the black portion more extended and of a deeper shade. Rare.

127. *virgunculu* Kirby.—Hind wings yellow, with black margins and spots; expands 1⅞ inches. Rare.

128. *Persephone* Grote.—Similar to the last species, but with broader stripes upon the front wings, and the black margin of the hind wing unbroken. Rare.

129. *Arge* Drury.—The black of the front wings is almost obliterated by the broad white bands; hind wings white, with a slight reddish tinge, and about six very small black spots near the outer margins; expands 2 to 2¼ inches. Not common. Feeds upon plantain, and is said to cause great destruction to young Indian corn in the Southern States.

PYRRHARCTIA Packard.

130. *Isabella* Smith.—The Isabella Tiger Moth. Tawny, with obscure black markings; hind wings lighter; expands 2 inches; abundant; feeds upon clover, dandelion, and plantain.

LEUCARCTIA Packard.

131. *acræa* Smith.—The Salt-marsh Moth. All the wings white in the female, with small black spots; the hind wings tawny yellow; expands 2 1-5 inches. Quite common; found feeding upon beet leaves by Mr. Gaumer. This species is abundant along the coast, where it is very destructive to the grass in salt-marshes. Its presence here is doubtless due to the abundant salt deposits of Kansas.

SPILOSOMA Stephens.

132. *Virginica* Fabr.—The Virginia Ermine Moth. Pure white, with one black dot upon each front wing, and two upon each hind wing; expands 1½ to 2 inches.

Common; devours peas, beans, corn, plantain, grasses, and sometimes grape, currant and gooseberry.

HYPHANTRIA.

133. *textor* Harris.—The Fall Web-worm or Weaver. Generally pure white, occasionally with black spots; expands 0.9 to 1.4 inches. Abundant from June to September. Spins a web as it feeds, and attacks a great many trees and other plants, especially pear, cherry, apple, Osage orange, and hickory.

ECPANTHERIA Hubner.

134. *scribonia* Stoll.—The Great Leopard Moth. White with numerous black rings upon front wings; expands 2½ inches. Rare; feeds upon sunflowers, plantain and willow (Riley).

HALESIDOTA Hubner.

135. *tessellaris* Smith.—The Checkered Tussock-moth. Pale yellow, semitransparent wings, the front pair crossed by smoky checkered bands; expands 1¾ to 2 inches. Quite common.

EUCHAETES Harris.

136. *Egle* Drury.—White, with yellowish margin to front wings; expands 1½ to 1¾ inches. Not common; feeds upon the common milkweed.

137. *Oregonensis* Stretch.—Similar to the preceding but without the yellow margin of front wings.

138. *Spraguei* Grote.—Slate color, with red margins. Rare; only one specimen.

LAGOA Harris.

139. *crispata* Packard.—Yellowish white, with dusky patches upon each front wing; very woolly; expands 1⅓ to 1¾ inches. Feeds upon the wild blackberry.

EUCLEA Hubner.

140. *pœnvata* Clemens.—Front wings green, with brown margins all around; hind wings dingy white; expands one inch. Not common.

PARASA Moore.

141. *chloris* H.-S.—Similar to the preceding but without brown upon inner margin. Rare.

EMPRETIA Clemens.

142. *stimulea* Clemens.—Seen only as a larva, which, from its peculiar markings, has been called the "Saddleback" larva. Feeds upon the pear. Rare.

PHOBETRUM Hubner.

143. *pithecium* Smith.—The Hag-moth. Seen only as a larva, which has curious fleshy "arms." Rare; feeds upon the crab-apple.

LACOSOMA Grote.

144. *chiridota* Grote.—Rare; one specimen, determined for me by Dr. Packard.

ICHTHYURA Hubner.

145. *inclusa* Hubner.—Grayish brown, the front wings crossed with whitish lines having a yellowish brown spot near the apex; expands 1⅙ inches. Not common.

146. *albosigma* Fitch.—Similar in color to the last but with the white lines more distinct, and the apical spot somewhat resembling the letter S; expands 1½ inches. Not common.

DATANA Walker.

147. *perspicua* G. and R.—The Sumac Moth. Bright yellowish brown, the front wings margined and crossed by darker brown lines; expands 1¾ to 2 inches. Abundant; double-brooded; feeds upon the common sumac (*Rhus glabra*).

148. *integerrima* G. and R.—Purplish brown, with lines as in the preceding; expands 1½ to 2¼ inches. Abundant; feeds upon the black-walnut and hickory.

GLUPHISIA Bois.

149. *trilineata* Packard.—Grayish brown, with three transverse lines on front wings; expands 1.15 inch. Not common.

150. *Gluphisia* n. sp.—Sent to Dr. Packard for determination.

HYPARPAX Hubner.

151. *aurora* Smith.—Alternately yellow and rose red; expands 1½ inches. Rare.

NADATA Walker.

152. *gibbosa* Smith.—Yellowish brown, each front wing crossed with two dark lines and having two white dots and a bright yellowish red spot near the center; expands 1.8 to 1.9 inch. Not common.

NOTODONTA Ochsenheimer.

153. *stragula* Grote.—Dull brown with reddish brown markings upon front wings; expands 1¾ inches. Rare.

154. *Notodonta* sp.—Taken by Dr. Carpenter at Leavenworth.

NERICE Walker.

155. *bidentata* Walker.—Grayish brown, each front wing with an irregular longitudinal dark brown band, bordered with white; expands 1.6 inches. Rare.

EDEMA Walker.

156. *albifrons* Smith.—Grayish brown, each front wing with an irregular whitish band along the outer half of the front margin; expands 1⅜ to 1⅝ inches. Common; feeds upon the oak.

DASYLOPHIA Packard.

157. *interna* Packard.—Taken by Dr. Carpenter at Leavenworth.

CŒLODASYS Packard.

158. *unicornis* Smith.—Ashy brown, with greenish tinge along front margin of front wings; expands 1⅓ to 1½ inches. Not common.

159. *biguttatus* Packard.—Front wings brown; hind wings dull white, with smoky margins; expands 1½ inches. Only one specimen.

160. *leptinoides* Grote.—Dark ashy brown; expands 1.6 inches. Rare, only one specimen taken.

HETEROCAMPA Doubl.

161. *obliqua* Packard.—Front wings dark brown, with reddish streaks; two or three oblique white patches near outer margins; hind wings whitish, with brownish margins; expands 2 inches. Rare; taken at Leavenworth by Dr. Carpenter.

162. *brunnea* G. and R.—One mutilated specimen; expands 2.15 inches.

163. *pulverea* G. and R.—Ash brown, darker on basal half of front wings; expands 2⅓ inches. Rare.

164. *Heterocampa* sp.—An undetermined species. Ash brown, with darker shades; expands 1.6 inches. Not common.

LOCHMÆUS Doubl.

165. *biundata* Walker.—Dark brown, with small reddish spots; expands 1¾ to 2 inches

166. *unicolor* Packard.—The Sycamore Moth. Uniform ash color; expands 1.9 inches. Rare; bred from the sycamore, by W. Osburn.

CERURA Schrank.

167. *borealis* Harr.—Ash color, with darker shades; a row of small dark spots near outer margin of front wings; expands 1⅓ inches. Not common.

168. *multiscripta* Riley.—A beautiful moth with front wings white, crossed by many wavy black lines; hind wings ash color; expands 1¼ to 1½ inches. Rare; taken by Dr. Carpenter at Leavenworth, and by T. B. Ashton at Tonganoxie.

TELEA Hubner.

169. *Polyphemus* Linn.—The American Silkworm. Varying from ash color to yellowish brown, with reddish tinges; a purple and brown narrow band near the margin of each wing; a transparent eye-spot upon each front wing, bordered narrowly with yellow and black; a larger black eye-spot upon each hind wing, with transparent center bordered with yellow, and with blue scales upon the black: expands 4½ to 5½ inches; feeds upon oak, walnut, hickory, basswood, elm, maple, hazel, apple, rose, quince, thorn, plum, choke-cherry, sycamore, poplar, birch, honey-locust and willow (Riley's 4th Report). Not rare; excellent silken fabrics may be made from the cocoon of this species.

TROPÆA Hubner.

170. *Luna* Linn.—Pale green, with front margin of front wings brown, an eye-spot upon each of the four wings, and long tails to the hind wings; expands 4 to 4⅝ inches. Common; feeds chiefly upon black walnut and hickory, sometimes also upon willow and plum.

SAMIA Hubner.

171. *Cecropia* Linn.—The largest of all our moths; expanding 5 to 7⅛ inches; general color brown; bases of wings reddish, a reddish white-bordered band crossing all the wings, the white border most conspicuous on the hind wings; a large reniform white and reddish spot at the center of each wing; a black eye-spot enclosing a narrow semicircle of blue, and a violet patch near the apex of front wings. Common; feeds upon apple, cherry, currant, barberry, hazel, plum, hickory, blackberry, elderberry, elder, elm, lilac, red-root, maple, willow, and honey-locust. (Riley's list of food-plants.)

BOMBYX Linnæus.

172. *mori* Linn.—The Chinese Silkworm. White, with faint smoky markings; expands 1 4-5 inches; introduced successfully, feeding upon our native Osage orange as well as upon the mulberry. The frequent cultivation of this species would seem to entitle it to a place in a list of Kansas insects.

CITHERONIA Hubner.

173. *regalis* Fab.—The Regal Walnut-moth. Front wings olive, with longitudinal red lines and seven or eight yellow spots; hind wings orange, spotted with olive and with yellow bases. Common; feeds upon the black walnut. The green caterpillar is 5 to 6 inches long, with long, yellow, black-tipped spines.

EACLES Hubner.

174. *imperialis* Drury.—The Imperial Moth. Yellow with brown bases, a brown central spot and a transverse brown band upon each wing; entire surface sprinkled with brown dots; the male with more brown than the female; expands 4 to 6 inches. Rare; feeds upon button-wood, pine, and oak.

EUCHRONIA Packard.

175. *Maia* Drury.—Buck Moth. Pale black, with a white band crossing each wing; a black, white-centered spot in the white of each wing; expands 2.3 to 3.1 inches. Not common; feeds upon oak, hazel and wild cherry; flies in November; occupies two years in making its transformations.

HYPERCHIRIA Hubner.

176. *varia* Walker (*Io* Harris).—Yellow with a large black white-pupiled eye-spot upon each hind wing, behind which are two narrow bands, a black and a red. In the female the front wings are reddish brown instead of yellow; expands 2½ to 3¾ inches. Not common; feeds upon false indigo, wild cherry, willow, poplar, hop-vine and corn.

DRYOCAMPA Harris.

177. *rubicunda* Fabricius.—The Rosy Dryocampa. Front wings rosy red, with a yellowish white band; hind wings yellowish white, with a narrow rosy band; expands 1¾ inches. Rare; one specimen taken at Leavenworth by Dr. Carpenter.

Var. *alba* Grote.—A western race of the preceding but very different in color, the female being generally of an unbroken white, while the males have a mere trace of rosy red upon each wing; expands 1½ to 2⅓ inches. Abundant, causing great destruction to the foliage of the soft maples in 1874 and 1875; the species is two-brooded.

178. *bicolor* Harris.—Front wings brownish or yellowish gray, with blackish dots; hind wings crimson; expands 2 to 2½ inches. Rare.

ANISOTA Hubner.

179. *senatoria* Smith.—Yellow, tinged with purplish and sprinkled with blackish dots; expands 2½ inches. Feeds upon the oak; rare, a single specimen taken at Leavenworth by Dr. Carpenter.

180. *pellucida* Smith.—Reddish brown, with centers of front wings transparent; expands 1.42 inches. Rare; a single specimen bred from the oak by G. F. Gaumer.

TOLYPE Hubner.

181. *Velleda* Stoll.—Pure white, with dusky markings; body woolly; expands 1½ to 2¼ inches. Rare; two specimens taken by T. B. Ashton at Tonganoxie.

CLISIOCAMPA Stephens.

182. *Americana* Harris.—The Tent-caterpillar Moth. Reddish Brown, with two white lines crossing each front wing; expands 1 to 1½ inches. Abundant: feeds upon apple and wild cherry; the eggs are laid in the fall, in bunches of 300 or 400, placed side by side and protected by a gummy secretion; these hatch in the spring and the caterpillars disfigure the trees with their web, often completely defoliating them.

XYLEUTES Hubner.

183. *robiniæ* Harris.—The Locust Borer. Black and gray, reticulated; the hind wings in the male have the lower half yellow; expands 2⅛ to 2¾ inches. Common; the caterpillar bores in the locust and red-oak.

FAMILY XIII.

NOCTUIDÆ: OWLET MOTHS.

For valuable aid in the determination of a large proportion of the 213 species in this family, and for many other favors, I am indebted to Mr. A. R. Grote, Director of the Museum of the Buffalo Society of Sciences, of Buffalo, N. Y.

LEPTINA Guenee.

184. *ophthalmica* Guenee.—Ash gray, with darker markings; expands .9 to 1.1 inches. Common.

RAPHIA Hubner.

185. *abrupta* Grote.—Ash gray, with basal half of front wings nearly black; expands 1 to 1½ inches. Common.

CHARADRA Walker.

186. *deridens* Guenee.—Rare; taken at Leavenworth by Dr. Carpenter.

MOMA Hubner.

187. *fallax* Herr.-Sch.—Front wings sea-green, with angular black spots; expands 1.40 inches. Rare.

ACRONYCTA Ochsenheimer.

The species of this genius are of different ashy shades, with a few short, black dashes upon the front wings, from which they have been termed Dagger-moths.

188. *vinnula* Grote.—Rare; expands 1 1-5 inches.

189. *grisea* (?) Barnston.—Rare; expands 1⅛ inches.

190. *morula* G. and R.—Rare; expands 2 inches.

191. *connecta* Grote.—Rare; expands 1¼ inches; feeds upon willow.

192. *lepusculina* Guenee (*Populi* Riley).—The Cottonwood Dagger. The ash color very light; expands 1¾ to 2 inches. Common; feeds upon cottonwood and willow.

193. *hastulifera* Abb. and Sm. (*Americana* Harris).—The hind wings very dark; expands 2.40 to 2.62 inches. Common; feeds upon maple, elm, basswood and chestnut.

194. *rubricoma* Guenee.—Rare; expands 1⅝ inches.

195. *clarescens* Guenee.—Dark hind wings; expands 1.55 inches. Not common.

196. *dissecta* G. and R.—Common; expands 1.12 to 1.28 inches.

197. *xyliniformis* Guenee.—Hind wings white; expands 1¾ inches. Rare; feeds upon oak, willow, rose, poison ivy, peach and persimmon (Riley's 5th Report).

198. *oblinita* Abb. and Sm.—The Smeared Dagger. Front wings relatively narrower than in the other species of this genus; hind wings white; expands 1.50 to 2.10 inches. Common; feeds upon peach, apple, willow, smartweed and buttonbush.

JASPIDEA Hubner.

199. *teratophora* Herr.-Sch.—One mutilated specimen; expands .90 inch

LITHACODIA Hubner.

200. *bellicula* Hubner.—Gray-brown, with a white triangular spot near the outer margin of each front wing; expands ¾ inch. Common.

MICROCŒLIA. Guenee.

201. *diphteroides* Guen.—Front wings pale green, with black spots and transverse wavy lines; expands 1¼ inches. Common.

AGROTIS Hubner.

This genus embraces what are termed the Cut-worm Moths, the larvæ being very destructive to field and garden crops, working at night, and cutting off close to the ground the young and tender stems of corn, potatoes tomatoes, cabbages, etc., etc.

202. *badinodis* Grote.—Dark brown, with two small square black spots on each front wing; the front wings are unusually broad. Not common.

203 *c-nigrum* Linn—Reddish brown, varied with black; one black mark near the centre of each front wing, having a fancied resemblance to the letter C; expands 2 inches. Not common.

204. *auxiliaris* Grote.—Dark brown, with lighter markings; expands 1.70 to 1.90 inches. Common.

205. *tricosa* Lintner.—Common; with broader wings than the next species, which it much resembles.

206. *subgothica* Haworth (*jaculifera* Riley).—No brief description can distinguish properly this from the preceding species; expands 1½ inches; is very abundant, and very destructive.

207. *lubricans* Guenee.—Front wings plain brown; hind wings white; expands only 1 1-5 inches. Not common.

208. *clandestina* Harris.—Dark brown; expands 2 inches. Not common.

209. *brunneicollis* Grote.—Rich brown, with a narrow black band near outer margin of front wings; collar velvety brown; expands 1½ inches. Not common.

210. *cupida* Grote.—Very much like the preceding in color and size, but without the dark-brown collar.

211. *Cochrani* Riley (*repentis* G. and R.).—The Climbing Cut-worm. Brown,

with black circles and wavy bands; expands 1½ inches. Common; climbs fruit trees and destroys the tender buds in spring.

212. *saucia* Hubn. (*inermis* Harr.).—Varying in color from blackish to reddish brown; expands 2 inches. Very abundant, and very destructive.

213. *velleripennis* Grote.—Front wings plain black; hind wings pearly white; expands 1⅓ inches. Rare.

214. *messoria* Harris.—Ash-brown, with transverse wavy dark lines; expands 1¼ inches. Common.

215. *annexa* Treitschke.—Two light central spots upon each front wing joined by a black dash; expands 1.60 inch. Common.

216. *suffusa* Guenee (*telifera* Harris).—Front wings dark brown, with lighter broad margins; one central light spot with black dash on each side of it; expands 2 inches. Common.

217. *Rilegana* Morrison.—Light brown, with darker spots; expands 1 1-5 to 1 1-3 inches. Common in October.

ADITA Grote.

218. *Chionanthi* Abb. and Sm.—Front wings ash, with black markings; hind wings white; expands 1⅔ inches. Rare.

MAMESTRA Ochs.

219. *latex* Guenee.—Front wings ashy white with a large red-centred discal spot; expands 2¼ inches. Rare; taken at Leavenworth, by Dr. Carpenter.

220. *grandis* Boisd.—Front wings ash brown, with two longitudinal black spots; hind wings dark brown; expands 1.95 inches. Taken at Tonganoxie, by Mr. T. B. Ashton.

221. *albifusa* Walker.—Ash-brown, the front wings with many small spots and wavy lines; expands 1⅓ inches. Not common.

222. *legitima* Grote.—Ash, varied with reddish brown; expands 1.40 inches. Rare.

223. *lorea* Guenee.—Light yellowish brown varied with darker brown; expands 1.40 inches. Rare.

DIANTHŒCIA Boisd.

224. *capsularis* Guenee.—Dark brown with clear ashy-white markings upon front wings; expands 1⅓ inches. Rare.

225. *meditata* Grote.—Reddish brown with irregular blue-gray lines and flecks; expands 1.30 inches.. Rare.

PACHYPOLIA Grote.

226. *atricornis* Grote.—Grayish black with white spots and lines; expands 2.05 inches. Rare.

HOMOHADENA Grote.

227. *Kappa* Grote.—Gray-brown, with a longitudinal black line upon each front wing; expands 1.40 inches. Rare.

HADENA Schrank.

228. *adjuncta* Boisd.—Blackish brown with bright white spots, expands 1 55 inches. Rare,

229. *cariosa* Guenee.—Dusky white, varied with brown and black; expands 1.60 inches. Rare; taken at Leavenworth by Dr. Carpenter.

230. *modica* Guenee.—Front wings bluish-gray, with dark brown irregular band across center; expands 1.15 inches. Rare.

231. *turbulenta* Hubn.—Front wings velvety brown, lighter on marginal half, expands 1.30 inches. Rare.

232 *miselioides* Guenee.—Light and dark brown with an olive tinge; expands 1.20 inches. Rare.

233. *Hadena* sp.—An undescribed species; front wings dark brown, on basal half, ash brown on outer half; expands .95 inch. Rare.

234. *chalcedonia* Hubn.—Front wings brown, with base and circular spot, at apex dusky white; expands .96 inch.

235. *renigera* Stephens (*herbimacula* Guenee).—Front wings purplish brown, with olive green spots; central spot green, with its lower edge silver white; expands 1.15 inches. Common; supposed by Riley to feed upon the roots of flowers.

PERIGEA Guenee.

236 *xanthioides* Guenee.—Bright yellowish-brown, with purple-brown markings; expands 1.20 inches. Abundant.

DIPTERYGIA Stephens.

237. *pinastri* Linn.—Front wings dark brownish black, with grayish white inner margins widening at the tip; when the wings are closed the light markings resemble a two-tined fork; expands 1½ inches. Common.

HYPPA Duponchel.

238. *xylinoides* Guenee. Ash-gray with three longitudinal black lines near inner margin of front wings; expands 1.65 inches. Rare; taken at Leavenworth by Dr. Carpenter

ACTINOTIA Hubner.

239. *ramosula* Guenee.—Gray and brown; expands 1.43 inches. Rare.

MORRISONIA Grote.

240. *evicta* Grote.—Gray-brown, with two longitudinal black lines and a reddish central spot; expands 1.35 inches. Rare.

PRODENIA Guenee.

241. *Commelinæ* Abb. and Sm. The Spiderwort Moth.—Front wings purplish-gray with brownish white bands and lines; hind wings pearly white; expands 1⅝ inches. Common; feeds upon spiderwort and (according to Riley) upon all sorts of succulent plants.

NEPHELODES Guenee.

242. *violans* Guenee.—Front wings rich purplish brown, with darker band across center; expands 1.70 to 1.80 inches. Common.

243. *Nephelodes* sp.—An undetermined form, resembling the preceding but with a double band crossing front wings; expands 1⅔ inches. Taken at Leavenworth by Dr. Carpenter.

GORTYNA Hubner.

244. *limpida* Guenee (*cerussata* Grote).—Brown, with three clusters of small white spots upon each front wing; expands 1½ to 1⅝ inches. Taken by Dr. Carpenter.

245. *nebris* Guen.—Brown, with two clusters of white spots upon each front wing; expands 1.43 inches. Rare.

246 *nitela* Guen. The Stalk-borer.—Brown, with a bent white line crossing front wings near outer margin; expands 1.45 inches. Common; bores into the stalks of potato, tomato, dahlia, aster and cocklebur.

247. *semiaperta* Morrison.—Reddish-brown, with double white spot in center of front wings; expands 1¼ inches. Common.

248. *cerina* Grote.—Golden yellow; one specimen, the type of the species.

ARZAMA Walker.

249. *densa* (?) Walk.—Reddish-brown of different shades; expands 1⅝ inches. One specimen.

CIRROPHANUS Grote.

250. *triangulifer* Grote.—Golden-yellow with brownish-yellow markings; expands 1.45 inches. Rare.

SCOLECOCAMPA Guenee.

251. *liburna* Geyer (*ligni* Guen).—Front wings brownish-white, with dark brown spot in center; expands 1.40 inches. Not common.

ACHATODES Guenee.

252. *zeæ* Harr. The Cornstalk Borer.—Dark brown, with rust-red thorax and apex of front wings; expands 1.40 inches. Not common as yet; bores in the stalks of Indian corn, and is very destructive in the New England States.

LUCANIA Treitschke.

253. *phragmitidicola* Guen.—Gray-brown, with a longitudinal black, white edged line upon each front wing; expands 1½ inches. Common.

254. *Harvegi* Grote.—Grayish-white with a broken longitudinal dark line; expands 1⅓ inches. Common.

255. *unipuncta* Haworth.—The Army-worm Moth. Yellowish brown; a small white spot in center of each front wing; longitudinal line indistinct; expands 1¾ inches. Abundant, especially in wet seasons following very dry seasons; probably the most destructive species among all the Lepidoptera, often attacking and destroying entire fields of corn, wheat, oats, grass and other staple crops.

UFEUS Grote.

256. *satyricus* Grote.—Uniform dull brown; expands 1¾ inches. Rare.

LAPHYGMA Guenee.

257. *frugiperda* Abb. and Sm. (*Prodenia autumnalis* Riley).—The Fall Army worm. Resembles the Spiderwort Moth (No. 241), but its markings are much less distinct. Common; destroys corn, wheat, tomatoes and many other plants; bred by W. Osburn from the bracted bindweed (*Calystegia*) and from false gromwell (*Onosmodium*).

PYROPHILA Hubner.

258. *pyramidoides* Guenee.—Brown front wings; rust-red hind wings; expands 1.80 inches. Very common; feeds upon the grape, raspberry, poplar, and red-bud.

ORTHODES Guenee.

259. *infirma* Guen.—Dark brown, interlaced with many narrow whitish lines; expands 1.40 inches. Rare.

ALETIA Hubner.

260. *argillacea* Hubn. (*Anomis xylina* Say.)—The Cotton-worm Moth. Front wings light purplish brown, with blackish spot in center; expands 1½ inches. The greatest enemy of the cotton-plant. Taken at Tonganoxie by T. B. Ashton.

ATETHMIA Hubner.

261. *pampina* Guen.—Light reddish-brown, with two dark spots near center of each front wing; expands 1.60 inches. Taken by T. B. Ashton at Tonganoxie.

ORTHOSIA Ochs.

262. *viatica* Grote.—Dark vinous brown; expands 2.10 inches. Rare.

263. *helva* Grote.—Light brownish-yellow with small blackish spots; expands 1⅓ inches. Rare.

XANTHIA Hubner.

264. *ferrugineoides* Guen.—Similar to the last species; expands 1.40 inches. Common.

GLÆA Hubner.

265. *anchocelioides* Guenee.—Reddish-brown with two dark spots at the center and one at the apex of front wings; expands 1⅓ inches. Rare.

SCOLIOPTERYX Germar.

266. *libatrix* Guen.—Front wings brown with jagged outer edges; bright red spots in the basal portion and a transverse white line between center and outer margin; expands 1.80 inches. Not common.

LITHOPHANE Hubner.

267. *petulca* Grote.—Front wings narrow and smoky-brown with many short darker lines; expands 1.70 inches. Not common.

268. *Bethunei* G. and R.—Light ash-gray with brown markings; expands 1½ inches. Rare.

269. *cinerea* Riley.—Dark ash-gray; expands 1¾ inches. Common; feeds upon the leaves of apple, poplar, hickory, and other trees, sometimes boring into the fruit. (Riley's 3d Report.)

CUCULLIA Schrank.

270. *asteroides* Guen.—Front wings cinereous, bordered with brown; expands 2 inches. Rare.

CRAMBODES Guenee.

271. *talidiformis* Guen.—Front wings brownish-white with darker markings and white discal spot; expands 1¼ inches. Abundant.

ADIPSOPHANES Grote.

272. *miscellus* Grote.—Ashy-white with many fine black streaks; expands 1.10 inches. Common; bred by W. Osburn from the hoary vervain (*Verbena stricta*).

NOLAPHANA Grote.

273. *malana* Fitch.—Ash-gray with darker lines; expands 1 inch. Not common.

274. *Zelleri* Grote.—Like the preceding in color and size. Common.

MARASMALUS Grote

275. *histrio* Grote.—Dark brown; expands 1 to 1.10 inches Common.

BASILODES Guenee.

276. *pepita* Guenee.—Satin-yellow, with brown circles and lines; expands 1 70 inches. Quite common.

PLUSIODONTA Guenee.

277. *compressipalpis* Guen.—Yellowish, with a brown, tapering band crossing each front wing obliquely, and forming a projecting tooth on inner margin, expands 1⅛ inches. Common.

TELESILLA Herr.-Sch.

278. *cinereola* Guen.—Front wings grayish-brown, crossed near outer margin by a yellowish band; expands 1.10 inches. Common.

PLUSIA Fabricius.

The members of this genus have a bright silver spot at center of each front wing.

279. *biloba* Stephens—Brown with a large two-lobed silver spot; expands 1.60 inch. Common.

280. *precationis* Guen.—Darker brown; expands 1.50 inch. Rare; bred from the common thistle by Riley.

281. *simplex* Guen.—Dark reddish-brown, with ashy edges to all the wings; expands 1½ inches. Abundant.

282. *gamma* Linn.—Ash-brown; expands 1.72 inch. Rare.

283. *brassicæ* Riley. The Cabbage Moth.—Brown, with minute ashy markings; silver spot double. Abundant; feeds upon the cabbage, gnawing large holes in the leaves.

STIRIA Grote.

284 *rugifrons* Grote.—Front wings bright-yellow; with outer margin, a spot at

base, and one at center of inner margin purplish-brown; hind wings white with smoky margin; expands 1.60 to 1.85 inches. Not common.

STIBADIUM Grote.

285. *spumosum* Grote.—Brown, frosted with gray scales, a bent line near outer margin, much resembling *Gortyna nitela*; expands 1.28 to 1.66 inches. Abundant.

PLAGIOMINICUS Grote.

286. *pityochromus* Grote.—Grayish-brown near center and another near apex of each front wing; expands 1.18 to 1.35 inches. Common.

SCHINIA Hubner.

287. *rectifascia* Grote.—Pale yellowish brown, with three or four whitish lines crossing each front wing; expands 1.08 inch. Rare.

CHLORIDEA Westwood.

288. *rhexiæ* Abb. and Sm.—Front wings pale-green, crossed by three whitish lines; hind wings white. Not common.

ORIA Guenee.

289. *sanguinea* Geyer.—Front wings purple-red, with brown band across the center; expands 1.20 inches. Rare; taken at Leavenworth by Dr. W. B. Carpenter.

ALARIA Westwood.

290. *gauræ* Abb. and Sm. Deep pink, varied with pure white; expands 1 to 1¼ inches. Common in localities; feeds upon the wild *Gaura*.

LYGRANTHŒCIA G. and R.

291. *marginata* Haworth.—Front wings ash-brown, darker at base and along margin, crossed by three curved white lines; expands 1⅛ inches. Not common.

292. *Thoreaui* G. and R.—Front wings olive-brown, crossed by a broad lighter band constricted centrally; expands 1⅛ inches. Not common.

293. *bimacula* Grote.—Rare.

294. *brevis* Grote.—Front wings rich brown, with yellowish lines and small spots; hind wings black, with yellow central and basal spots; expands 1.15 inches. Rare; taken at Topeka by E. A. Popenoe, at Leavenworth by Dr. Carpenter, and at Tonganoxie by T. B. Ashton.

295. *arcifera*.—Dark brown, with a lighter constricted band across front wings; expands .90 inch. Not common.

296. *Spragueï* Grote.—Front wings like preceding, but lighter; hind wings with basal half yellow; expands 1 inch. Common.

297 *lynx* Guenee.—Similar to preceding, but lighter and with a blackish spot in the yellow of hind wings. Common.

298. *Lygranthœcia* sp.—An undetermined species; yellowish brown, with the usual lighter band upon front wings; expands 1.15 inch. Rare.

EULEUCYPTERA Grote.

299. *cumatilis* Grote.—Satin-white, with basal and terminal bands of greenish upon front wings; expands 1 inch. Rare.

TRICOPIS Grote.

300. *chrysellus* Grote.—Satin-white, with a basal, a central and a terminal yellowish brown band upon each front wing; expands .90 to 1 inch. Not common.

TAMILA Guenee.

301. *nundina* Drury.—White, with irregular greenish bands and a double black spot upon each front wing; expands 1⅛ inches. Rare.

ÆDOPHRON Lederer.

302. *Snowi* Grote.—Creamy white, tinged with pink. Rare; a single specimen taken by G. F. Gaumer in 1872.

HELIOTHIS Hubner.

303. *phlogiphagus* G. and R.—Front wings dull yellowish-brown, with a central black spot; hind wings pale yellowish,with alarge black central spot, and broad black margin enclosing yellowish spot; expands 1.40 inch. Not common; feeds upon phlox.

304. *armigera* Hubn.—The Cotton or Boll-worm Moth. Front wings brownish yellow, with a small dark central spot; hind wings dingy with blackish margin enclosing a light spot; expands 1.70 inches. Common; feeds upon unripe corn in the ear, often causing great destruction, and upon the cotton-ball in the cotton States; also attacks the green fruit of the tomato. (Riley.)

Var. *umbrosus* has greenish-yellow instead of brownish-yellow front wings.

HELIOCHILUS Grote.

305. *paradoxus* Grote.—Front wings light greenish brown, with a pale drab discal spot; hind wings much as in the preceding; expands 1⅛ inch. Rare.

PYRRHIA Hubner.

306. *exprimens* Walker.—Yellowish-brown, with rosy tinges; expands 1½ inches Rare. Bred by W. Osburn, from the black-walnut.

TARACHE Hubner.

307. *aprica* Hubn.—White with broad brown terminal margin and one or two brown spots upon front margin of front wing; expands 1 inch. Common.

Var. *biplaga* Guenee, has the brown more extended.

308. *erastrioides* Guen.—Front wings white with lower portion of terminal half brown; hind wings dusky; expands ¾ inch. Not common.

309. *candefacta* Hubn.—Front wings about equally white and olive brown; terminal half of hind wings dusky; expands .80 inch. Common.

Var. *debilis* has the white more extended.

GALGULA Guenee.

310. *hepara* Guen.—Front wings dark purplish-brown, darker on basal half; hind wings plain brown; expands 1 inch. Rare.

311. *subpartita* Guen.—Light reddish-brown to ash-brown, with dark spot at centre of front margin; expands 1 inch. Common.

XANTHOPTERA Guenee.

312. *nigrofimbria* Guen.—Front wings pale yellow with brown fringes and two brown dots near the center; expands .95 inch. Rare.

EUSTROTIA Hubner.

313. *carneola* Guen.—Front wings dark brown with broad lighter terminal margin, the dark portion crossed by an oblique flesh-colored band; expands .85 inch. Abundant.

314. *musta* G. and R.—Light and dark brown with greenish tinge; expands ¾ inch. Common.

CHAMYRIS Guenee.

315. *cerinthia* Tr.—Brownish-black with blue tinges and with white bands and lines; expands 1.20 inches Rare.

EROTYLA Hubner.

316. *leo* Guenee.—Front wings black, white, and orange; hind wings black; expands .70 inch. Rare.

METOPONIA Duponchel.

317. *obtusa* H.-S.—Front wings yellow with brown spots; expands .92 inch Common.

DRASTERIA Hubner.

318. *erichtea* Cramer.—Brown with darker spots and bands; female more uniform in color; expands 1¾ to 2 inches. Abundant. Feeds upon clover.

Var. *agricola* is quite common.

EUCLIDEA Hubner.

319. *cuspidea* Hubn.—Dark brown with lighter edges and nearly black, angular spots upon front wings; expands 1.40 to 1.65 inches. Common.

PARALLELIA Hubner.

320. *bistriaria* Hubn.—Brown, the front wings crossed by two parallel lines; expands 1½ to 1⅔ inches. Common.

AGNOMONIA Hubner.

321. *anilis* Drury (*sesquistriaria* Hubn.)—Front wings dark velvety-brown with one and a half white transverse lines; hind wings plain brown; expands 1.40 inches. Common.

CELIPTERA Guenee.

322. *frustulum* Guenee.—Front wings ashy-brown with wavy lines; near the outer edges runs a very distinct dark brown line, edged within by a lighter line and followed by a row of black dots on the inner margin near the base; expands 1⅔ inches. Rare.

BOLINA Duponchel.

323. *Bolina* sp.—An undetermined species is in the collection of E. A. Popenoe at Topeka.

PARTHENOS Hubner.

324. *nubilis* Hubn.—Front wings brown with whitish shades; hind wings black with irregular yellow bands and spots, much resembling the next genus. Rare; a single specimen taken at Leavenworth by Dr. Carpenter.

CATOCALA Schrank.

The members of this large and beautiful genus have been unusually abundant during the past season (June to September, 1875), the number of species known to occur in Kansas having been increased from fifteen to forty. All but five of these have been taken at Lawrence, chiefly by Mr. Gaumer and the writer. Thirty species have been taken at Tonganoxie by Mr. T. B. Ashton, and nearly an equal number at Leavenworth, by Dr. Carpenter. As no brief description would enable one to distinguish these closely-allied forms, the forty species are divided into four well-marked groups, based upon the colors of the hind wings. The front wings are always of some shade or shades of ash or brown, often varied with black — colors admirably adapted to conceal the moths when in their usual resting places upon the trunks of trees.

FIRST GROUP: Hind wings black and unbanded.

325. *Epione* Drury.— Expands 2½ inches. Abundant.

326. *lachrymosa* Guenee.— Expands 3 inches. One specimen by Mr. Gaumer.

327. *Robinsoni* Grote.— Expands 2.90 inches. Not common.

328. *Levettei* Grote (*Judith* Strecker).— Expands 2.10 inches. Rare; taken at Tonganoxie by Mr. Ashton, and at Leavenworth by Dr. Carpenter.

329. *insolabilis* Guenee.— Hind wings with black fringes; expands 2.90 inches. Common.

330. *simulatilis* Grote.— Expands 2.90 inches. One specimen taken by Mr. Gaumer.

331. *obscura* Strecker.— Expands 2.45 to 2.90 inches. Taken by Mr. Ashton. Much resembles the preceding species, but the t. p. and the t. a. lines are separated

on the inner margin of the front wings only 0.08 inch, while in *simulatilis* they are separated 0.23 inch.

332. *viduata* Guenee.— Expands 3½ inches. Rare; taken by Mr. Gaumer, in the tops of high elm trees.

333. *desperata* Guenee.— Expands 3.10 to 3.50 inches. Common.

334. *retecta* Grote.— Expands 2¾ inches. Not common.

335. *flebilis* Grote.— Expands 2.80 inches. Rare; taken by Mr. Ashton and Dr. Carpenter.

SECOND GROUP: Hind wings red with two black bands (a central and a terminal).

336. *Walshii* Edwards.— Expands 3.20 to 3.40 inches. Not rare.

337. *parta* Guenee.— Expands 3½ inches. One specimen, taken by Miss A. E. Mozley; feeds upon willow.

338. *coccinata* Grote.— Expands 2⅔ inches. Taken by Dr Carpenter and Mr. Ashton.

339. *ultronia* Hubner.— Expands 2 to 2¼ inches. Common.

340. *amatrix* Hubner.— Expands 3.40 inches. Common.

341. *cara* Guenee.— Expands 3⅓ inches. Not common.

342. *Ilia* Cramer.— Expands 3.15 to 3.50 inches. Common.

343. *Snowiana* Grote Mss.— Allied to *Ilia;* one specimen only.

THIRD GROUP: Hind wings yellow, with the two black bands.

344. *innubens* Guenee.— Expands 2½ to 2¾ inches. Abundant.

Var. *scintillans* Grote, is quite common.

345. *adoptiva* Grote (*Delilah* Strecker).— Expands 2.40 to 2.55 inches. Rare.

346. *neogama* Guenee.— Expands 3 to 3¼ inches. Abundant.

347. *subnata* Grote.— Expands 3.45 to 3.60 inches. Common, especially at Tonganoxie.

348. *piatrix* Grote.— Expands 3 to 3⅓ inches. Abundant.

349. *palæogama* Guenee.— Expands 2.60 to 2.90 inches. Abundant.

Var. *phalanga* also occurs.

350. *consors* Abb. and Sm.— Expands 2.40 inches. Not common.

351 *nebulosa* Edwards (*ponderosa* G. and R.).—Expands 3 to 3.45 inches. Rare.

352. *serena* Edwards.— Expands 2.35 inches. Rare; one specimen, taken by A. Atchison.

353. *illecta* Walker (*Magdalena* Strecker).—Expands 2.60 inches. Rare; taken at Lawrence by Miss M. E. Brett, and at Tonganoxie by Mr. Ashton.

354. *nuptialis* Walker (*Myrrha* Strecker).—Expands 2 inches. Common.

355. *abbreviatella* Grote.—Closely allied to the preceding, of which it is probably a variety; it is of a lighter color, and has the black reniform spot annulate with an ash-gray centre. Rare; one specimen taken by Mr. Gaumer.

356. *polygama* Guenee.— Expands 2 inches. Not common.

357. *mira* Grote Mss.— Allied to the preceding. Rare; taken by Mr. Gaumer.

358. *Amasia* Abb. and Sm.— Expands 1.85 inches. One specimen taken by Mr. Gaumer.

359. *Catocala* sp.— An undetermined species, taken at Leavenworth by Dr. Carpenter; expands 1.95 inches. One specimen only.

360. *Grynea* Cramer.— Expands 1⅞ inches. Quite common.

361. *fratercula* G. and R.— Expands 1.80 inches. Not common.

362. *minuta* Edwards.— Expands 1.70 inches. One specimen only.

FOURTH GROUP: Hind wings yellow without central band.

364. *Belfragiana* Harvey (*jocasta* Streecker). Expands 1.95 inches. Rare;

taken by Dr. Carpenter and Mr. Gaumer. The specimens agree very well with the description of *messalina* Guenee.

SPILOLOMA Grote.

365. *lunilinea* Grote.— Ash-brown, with four small black spots on front margin of front wings; a dark line upon the inner half of the centre of each wing; expands 1.90 to 2.25 inches. Rare.

PANOPODA Guenee.

366. *rufimargo* Hubn.— Brown, the front wings crossed by a dark-brown between two reddish lines; collar and front edge of front wings red; expands 1.85 inches. Rare.

367. *carneicosta* Guenee.— Much like the last, but with margins of front wings flesh-colored, and with two black spots near the centre of each front wing; expands 1¾ inches. Not common.

REMIGIA Guenee.

368. *latipes* Guenee.— Colored and marked much like No. 366; the hind pair of legs very broadly fringed; expands 2.05 to 2.20 inches. Not common.

HOMOPTERA Boisd.

369. *lunata* Drury.—Wood-brown, with darker curved lines; expands 1.90 to 2.20 inches. Abundant.

370. *Saundersii* Bethune.—Like the last, but with a narrow milk-white line near outer edge of each wing. Common.

371. *edusa* Drury.—Like the last two species in size and color; a broad milk-white band near edge of each wing. Common.

PSEUDANTHRACIA Grote.

372. *coracias* Guen.—Dark brown, with black spots and lines; expands 1½ inches. One specimen only.

ZALE Hubner.

373. *horrida* Hubn.—Brownish-black, with a broad light brown margin upon each wing; expands 1.55 inches. One specimen.

MATIGRAMMA.

374. *pulverilinea* Grote.—Ash-brown, with lighter margins; surface powdered with gray scales; expands 1¼ inches. Rare.

SPARGALOMA Grote.

375. *sexpunctata* Grote.—Ash-brown, with several small black spots near apex, and a black band across center of each front wing; expands 1⅛ inches. Rare.

PHALÆNOSTOLA Grote.

376. *larentioides* Grote.—Brown, with two dark bands across each wing; expands .82 inch.

PSEUDAGLOSSA Grote.

377. *lubricalis* Geyer (*Helia phœalis* Guen).—Dark brown, with lighter shades; expands 1 inch. Common.

378. *denticulatus* Harvey.—Brown, with whitish spots and lines; a black spot near apex of each front wing; expands 1.30 inch. Rare.

HOMOPYRALIS Grote.

379. *tactus* Grote.—Dark brown, with small light spots along front margin of front wings; expands 1 inch. Not common.

PALTHIS Hubner.

380. *angulalis* Hubn.—Brown, with an irregular black band across each front wing; expands 1.10 inches. Rare.

PHALÆNOPHANA Grote.

381. *rurigena* Grote.—Brownish-white, with darker shades; expands .90 inch. Rare.

BLEPTINA Guenee.

382. *caradrinalis* Guen.—Pale brown, with dark spot near center of each front wing; expands 1.05 inch. Rare.

RENIA Guenee.

383. *Renia* sp.—An undetermined species, similar in color to the last; expands 1.10 inch. Rare.

BOMOLOCHA Hubner.

384. *Baltimoralis* Guenee.—Light and dark brown; expands 1⅓ inches. Rare.

385. *bijugalis* Walker.—Dark brown, with a light band across each front wing and a light spot near the apex. Rare.

HYPENA Schrank.

386. *humuli* Harris. The Hop-vine Hypena.—Front wings blackish brown, sometimes lighter, crossed by two dark lines; long feelers very conspicuous in front; expands 1.30 inches. Abundant; feeds upon the hop-vine, often being very destructive.

387. *Hypena* sp.—An undetermined species, taken at Leavenworth by Dr. Carpenter.

PLATYHYPENA Grote.

388. *scabra* Fabr.—Much like the preceding in appearance; expands 1.40 inch. Abundant.

FAMILY XIII.

PHALÆNIDAE. THE GEOMETRIDS.

The larvæ of this family have been called span-worms or geometers, on account of their mode of locomotion: reaching forwards they grasp the surface over which they are moving, with their front legs, and then bring up the hind legs to the same spot, forming an arch or loop with the body. The moths, when at rest, do not close the front wings over the hind wings, but allow them to remain extended. For aid in the determination of these moths, I am indebted to A. S. Packard, Jr., M. D., of Salem, Mass., who is preparing a monograph upon this difficult family. As much of my material has not yet been returned, several of the species are introduced without comment.

APLODES Guenee.

389. *mimosaria* (?) Guenee.—Bright green, each front wing crossed by two white lines; expands 1¼ inches. Rare.

EUCROSTIS Hubner.

390. *chloroleucaria* Guen.—Pale green, with a white band crossing each wing; expands ⅔ inch. Common.

SYNCHLORA Packard.

391. *rubivoraria* Riley. The Raspberry Geometer.—Same color as the last; each wing crossed by two whitish lines. Common; feeds upon the fruit of the raspberry and blackberry; sometimes unwittingly eaten with these fruits.

SEMIOTHISA Packard.

392. *Californiata* Packard.—Rare.

393. *ocellinata* Guenee.—Ash-gray, with darker margins; expands 1 inch. Common; bred from the common locust (*Robinia pseudacacia*) by W. Osburn.

ASPILATES Treitschke.

394. 4-*fasciata* Packard.—White, the front wings with four, the hind wings with two narrow dusky bands; expands 1.17 inches. Rare.

395. *pervaria* Pack.—Dusky white; expands 1.28 inches. Rare.
396. *dissimilaria* Hubner.

CORYCIA Duponchel.

397. *Corycia* sp.—An undetermined species; pure silky white; expands 1.10 inch.
398. *hermineata* Guenee.

HÆMATOPIS Hubn.

399. *grataria* Fabr. The Chickweed Geometer.—Yellow, with red bands upon all the wings and a red central spot upon each front wing; expands 1 to 1.05 inch. Feeds upon chickweed. Exceedingly abundant.

PHASIANE Duponchel.

400. *mellistrigata* Grote.—Ash-color, each wing crossed by a very distinct brown band, that upon the front wings having a yellowish edge; expands 1 inch. Common.
401. *Snoviata* Packard.—Rare.

LYTHRIA Hubner.

402. *Snoviana* Packard.—Rare.

ANGERONA Dup.

403. *crocataria* Fabr. The Strawberry Geometer.—Bright yellow, with brown spots; expands 1.45 to 1.65 inches. Common; feeds on the strawberry.

ENDROPIA Guenee.

404. *hypochraria* H.-Sch.—Dark brown, with broad outer margins of a lighter brown; expands 1.50 to 1.62 inch.
405. *effectaria* Walker.—Light brown, with broad margins of a darker brown; expands 1½ inches.
406. *serrata* Drury.—Light yellow, with broad brown margins; expands 1.95 inches.
407. *mugaria* (?) Walk.—Dingy brown, crossed by darker lines; expands 1.35 in.
408. *trilinearia* Pack.
409. *Endropia* sp. (near *aufuctaria*).
410. *Endropia* sp.—An undetermined species.

CABERODES Guenee.

411. *metrocamparia* Guen.—Dusky white, each wing with brown discal spot and transverse narrow band; expands 1.70 inches.
412. *confusaria* Hubn.

TETRACIS Guenee.

413. *crocallata* Guen.—A mutilated specimen.

NEMATOCAMPA Guenee.

414. *filamentaria* Guen.—Yellowish-brown, with reddish brown lines and dots; expands ¾ inch. Feeds upon the strawberry.

CHŒRODES Guenee.

415. *Chœrodes* sp.—An undetermined species; yellowish brown with darker broad margins; expands 2⅛ inches. Common.

ABRAXAS Leach.

416. *ribearia* Fitch. The Currant-worm Moth.—Yellowish white, with smoky markings; expands 1.30 to 1.40 inches. Common; devours the foliage of the currant and gooseberry, often stripping the bushes of every leaf.

ENNOMOS Treits.

417. *magnaria* Guenee.—Yellow, with brownish margins and spots; expands 1.90 inches.

SELENIA Hubner.

418. *Selenia* sp.—An undetermined species.

PRIOCYLA Guenee.

419. *bilinearia* Pack.—Yellowish brown, with three black spots upon each front wing; expands 1½ inches.

420. *armataria*.—Light grayish brown, with transverse reddish lines upon each wing; expands 1 inch. Common; feeds upon the currant and gooseberry.

PLEMYRIA Hubner.

421. *fluviata* Hubn.—Reddish brown, crossed by several whitish lines; expands .80 inch.

422. *multilineata* Pack.—Reddish brown, crossed by many whitish lines; expands .95 inch.

HYPERETIS Guenee.

423. *alienaria* H.-Sch.

HETEROLOCHA Lederer.

424. *sulphuraria* Pack.—Taken at Leavenworth, by Dr. Carpenter.

EUTRAPELA Hubner.

425. *transversata* Drury.

EUPHYJA Hubner.

426. *senulata* Pack.

EPIONE Dup.

427. *depontanata* Grote.—Yellow, with brown margins; expands 1.40 inches.

428. *Epione* sp.—An undetermined species, probably new.

AZELINA.

429. *Hubnerarii* Pack.

AMPHIDASIS Treitschke.

430.—*cognataria* Guenee.—Gray, with blackish lines and minute spots; very stout body; expands 2¼ inches. Feeds upon the gooseberry, Missouri currant, and *Spiræa* (Packard).

CYMATOPHORA Treits.

431. *ambrosaria* Hubn.

432. *pampinaria* Guenee.—Gray, crossed by three black lines upon front wings, only one or two lines upon hind wings; expands 1.45 inches.

BRONCHELIA Guenee.

433. *hortaria* Guenee.—Grayish white, crossed by several blackish wavy lines; expands 2.10 inches.

PARAPHIA Guenee.

434. *deplanaria* Guenee.

CODONIA Hubner.

435. *pendulinaria* Guenee.

ACIDALIA Treits.

436. *purata* Guenee.

437. *5-lineata* Pack.

MACARIA Curtis.

438. *subminiata* Pack.—Grayish, with vermillion suffusion; expands 1 inch.

PSAMMATODES Guenee.

439. *eremiata* Guenee.

CIDARIA Treits.

440. *diversilineata* Hubn.—Yellow, varied with brown; expands 1.40 inches.

EUPITHECIA Curtis.

441. *Eupethecia* sp.—An undetermined species.

FAMILY XIV.

PYRALIDÆ: SNOUT-MOTHS, OR DELTOIDS.

So called from their slender, elongated feelers or palpi, extending directly forward from the head.

PYRALIS Schrank.

442. *farinalis* Harr. The Meal Moth.—Reddish-brown at base and tip of front wings; elsewhere grayish-brown, crossed by white lines; expands 0.95 inch. Common; found in old flour boxes and in barns.

PANTOGRAPHA Lederer.

443. *limata* G. and R.—Yellowish-white, semi-transparent, with a large brown area upon the lower two-thirds of outer margin of each front wing; brown lines and circles upon the yellowish portions; expands 1.40 inches. Not common. Taken at Leavenworth by Dr. Carpenter.

PHACELLURA Guilding.

444. *hyalinatalis* Linn. Cucumber Moth.—Pearly, semi-transparent white, with regular, broad brown margins. Common; damages cucumbers by boring into them.

445. *nitidalis*.—Taken at Manhattan by H. A. Brous. Has the same habits as 444.

ASOPIA Treitschke.

446. *olinalis* Guenee.—Purplish brown, with yellowish markings; expands 1 inch. Common.

447. *squamealis* Grote.—Purplish-brown; expands 0.90 inch. Rare.

HYDROCAMPA Guenee.

448. *germinalis* Lederer.—White, with black and yellow markings; expands 0.75 to 0.85 inch. Taken over water surfaces, the larvæ being aquatic in their habits.

BOTYS Latreille.

449. *flavidalis* Guenee.—Pale yellow, with about four wavy brown lines crossing all the wings: expands 1.10 to 1.40 inches. Common.

450. *plectilis* G. and R.—Grayish brown, with whitish spots; expands ¾ inch. Common.

451. *penitalis* Grote Mss. The Lily Moth.—Yellowish brown, with wavy lines of a darker shade; expands 1.20 inches. Common; feeds upon the "receptacle" of the Western water-lily (*Nelumbium luteum*); also bred from dogs-bane (*Apocynum cannabinum*).

452. *argyralis* Hubn.—Light yellowish brown, with whitish spots; expands 1 inch. Common.

453. *ventralis* G. and R.—Smoky brown, with whitish spots; expands 1 inch. Not common.

454. *generosa* G. and R.—Dark brown, with yellow spots; expands ⅞ inch. Not common.

455. *sexmaculalis* Grote Mss.—Yellowish-white, with from 6 to 8 bright brown black-edged spots upon each front wing; expands .75 to .85 inch. Rare.

456. *diffissa* G. and R.—Front wings purple, with a yellow band; hind wings brick-red; expands .70 inch. Rare.

457. *Botys* sp.—An undetermined species, varying from yellowish-brown to smoky-brown; expands ⅞ inch. Abundant.

458. *Botys* sp.—Yellow, with brown and purplish markings; expands .80 inch. Common; bred by W. Osburn from the wild sage (*Salvia*).

459. *Botys* sp.—Yellow and purple; expands .60 inch. Rare.

DESMIA Westwood.

460. *maculalis* Westw. The Grape-vine Leaf-folder.—Black, with white spots, two upon each front wing and one upon each hind wing; expands .95 to 1.20 inch. Common; feeds upon the grape-vine, the leaves of which it folds together.

NOMOPHILA Hubner.

461. *noctuella* W. V.—Brown of different shades; expands 1¼ inches. Abundant.

PEMPELIA Hubner.

462. *Pempelia* sp.—White with blackish markings; expands 1 inch. Rare.

463. *Pempelia* sp.—Ashy brown; expands .95 inch. Rare.

CRAMBUS Fab.

464. *exsiccatus* Zeller.—Grayish with darker markings; expands 1 inch. Common.

465. *Crambus* sp.—Grayish-white; expands 1 inch.

CRYPTOLECHIA Zeller.

466. *Schlægeri* Zeller.—White with gray markings; expands .85 to 1 inch. Rare.

GALLERIA Zeller.

467. *cereana* Fabr. Bee-moth.—Dusky-gray with brown markings; expands 1¼ inch. Common; very destructive to the "comb" in bee-hives.

ARGYRIA Hubner.

468. *chamæchryulla* Walker.—Satin-white, with very narrow brown outer edge upon front wings; expands .80 to .95 inch. Common.

CONCHYLODES Guence.

469. *platinalis* Guen.—Semi-transparent white, with black ring in centre of each front wing and black lines upon all the wings; expands 1.08 inch. Rare.

SCHŒNOBIUS Duponchel.

470. *longirostrellus*.—Yellow, with a narrow brown oblique band from apex of each front wing; expands .92 inch. Rare,

CONDYLOPEZA Zeller.

471. *nigrinodis* Zeller.—Reddish-brown; expands .70 inch. Rare.

LIPOCOSMA Lederer.

472. *nivalis* Walker.—Dull white, with centre of hind wings black; expands .60 inch. Rare.

OMPHALOCERA Lederer.

473. *cariosa* Lederer.—Dull brown, with darker spot upon each front wing; expands 1¼ inch. Rare.

FAMILY XV.

TORTRICIDÆ. LEAF-ROLLERS.

TORTRIX Treitschke.

474. *sulphureana* Clemens.—Sulphur-yellow, with red spots; expands .80 inch. Common.

475. *Rileyana* Grote.—Ochre-yellow, with small square brown spots upon front wings; expands .85 inch. Common; feeds upon buckeye (bred from it by Mr. Gaumer), walnut, hickory, and snowberry. (Riley.)

476, 477, and 478. *Tortrix* sp.—Three undetermined species.

LOXOTÆNIA Stephens.

479. *rosaceana* Harris.—Yellowish brown, with darker bands; expands 1.15 inches. Common; destroys the tender leaves of the apple.

CARPOCAPSA Treitsch.

480. *pomonella* Linn. The Codling Moth.—Brown, crossed by many gray and brown lines; a large dark brown spot with copper edge on lower half of tip of front wings. Common; is the cause of "wormy apples," the larva burrowing into the fruit from the "blossom end," and generally causing it to fall to the ground before ripening.

PENTHINA Treitsch.

481. *vitivorana* Pack. The Grape Codling.—Light bluish, with a brown band and one or two brown spots upon each front wing; expands 0.40 inch. Not common; feeds upon the pulp of the grape.

GRAPHOLITHA Lederer.

482. *Grapholitha* sp.—An undetermined species; brown, with a yellowish white spot on lower half of the outer margin of front wings; expands 0.80 inch. Common.

PŒCILOCHROMA Clemens.

483. *dorsisignatum* Clemens.—Ash color, with black spot at centre of inner margin of each front wing; expands 0.85 to 0.95 inch.

CONCHYLIS Treits.

484. 5-*maculana* Robinson.—Brown, with five white spots upon each front wing; expands $\frac{2}{3}$ inch. Rare.

FAMILY XVI.

TINEIDÆ. THE TINEIDS.

The members of this family have the wings long and narrow, with long fringes; from their diminutive size they have been called "*micro-lepidoptera.*"

TINEA Fabricius.

485. *flavifrontella* Linn. The Clothes Moth.—Yellowish white; expands $\frac{1}{2}$ inch. Common; very destructive to woolens and furs.

ŒTA Grote.

486. *compta* Clemens. The Ailanthus Moth.—Front wings bright orange yellow, with transverse rows of pale yellowish spots; hind wings dusky; expands 0.85 inch. Rare; feeds upon the ailanthus tree.

HYPONOMEUTA Zeller.

487. *multipunctella* Clemens. The Wahoo Moth.—Snowy white with longitudinal rows of black dots upon the front wings; female with hind wings blackish gray, and basal portion of anterior edge of front wings black; expands 0.90 inch. Not common. Bred from the wahoo (*Euonymus atropurpureus*), by G. F. Gaumer, who has described this insect in all its stages.

PRONUBA Riley.

488. *yuccasella* Riley. The Yucca Moth.—Front wings pure white; hind wings grayish brown; expands 0.95 to 1.10 of an inch. Taken in Western Kansas, by H. A. Brous; feeds upon the wild species of *Yucca*, being essential to the "fertilization" of that genus of plants, as discovered by Mr. Riley.

FAMILY XVII.

PTEROPHORIDÆ. PLUME MOTHS.

PTEROPHORUS Geoffr.

The members of this genus have the front wings cleft, and the hind wings parted into three divisions.

489. *periscelidactylus* Fitch. The Grape Plume.—Yellowish brown, with spots of white and dark brown; expands .60 inch. Not common; feeds upon the young leaves of the grape vine, which it fastens together with silky threads.

ADDENDA.

Since the foregoing went to press, the following additions have been made:

ORGYIA Ochs. (*Bombycidæ*, four species.)

490. *leucostigma* Sm. The white-marked Tussock-moth.—Not common.

DATANA Walker.

491. *ministra* Drury. The Handmaid Moth.—Common and destructive.

PTILODONTES.

492. *Ptilodontes* n. sp.—One specimen, taken by Mr. Gaumer.

ARCTIA Schk.

493. *Snowi* Grote.—Described in Can. Entomologist for Oct., 1875.

JASPIDEA Hubner. (*Noctuidæ*, eight species.)

494. *Jaspidea* sp.—An undetermined species.

AGROTIS Hubn.

495. *venerabilis* Walk.—Not common.

DORYODES Walker.

496. *acutaria* H.-Sch.—Grayish white, with a broad, brownish, longitudinal band upon each front wing; expands 1½ inches.

CARADRINA Ochs.

497. *grata* Hubn.—Reddish-brown, each front wing crossed by two whitish lines, expands .90 to 1.05 inches. Common.

PLUSIA Fabr.

498. *pedalis* Grote.—Described in Can. Ent. for Nov., 1875.

HELIOTHIS Hubner.

499. *luteitinctus* Grote.—Allied to *phlogiphagus*.

BOLINA Dup.

500. *jucunda* Hubn.—One specimen, taken by Wm. Osburn.

EREBUS Latreille.

501. *odora* Linn.—Taken at Manhattan, by H. A. Brous; expands 6 inches.

ANISOPTERYX Steph. (*Phalænidæ*.)

502. *vernata* Peck. The Spring Canker-worm Moth.—Rare.

LIPOCOSMA Lederer. (*Pyralidæ*.)

503. *albolineata* G. & R.—Rare.

SUMMARY OF SPECIES.

Diurnal Lepidoptera, or Butterflies	77
Sphingidæ, or Hawk Moths	27
Ægeriadæ, or Ægerians	4
Zygænidæ	4
Bombycidæ, or Silkworm Moths	75
Noctuidæ, or Owlet Moths	213
Phalænidæ, or Geometrids	54
Pyralidæ, or Snout Moths	33
Tortricidæ, or Leaf-rollers	11
Tineidæ, or *Tineids*	4
Pterophoridæ, or Plume Moths	1
Total number of species catalogued	503

METEOROLOGICAL SUMMARY FOR 1875.

PROF. F. H. SNOW'S ANNUAL REPORT AS METEOROLOGIST TO THE STATE BOARD OF AGRICULTURE.

Station: Lawrence, Kansas; latitude 38° 58′; longitude 95° 16′; elevation of barometer and thermometers, 884 feet above the sea level, and 14 feet above the ground; rain gauge on the ground; anemometer 105 feet above the ground, on the dome of the University building, 1,150 feet above the sea level.

The following features of the weather of 1875 deserve special notice:

1. The very low mean temperatures of January and February, and the generally low mean temperatures of the remaining months of the year, except December, which was remarkably warm, being more than 12° warmer than the December average, and nearly 4° warmer than November.

2. The large deficiency in the rainfall for the months of August, September, October and November. The rains during the preceding months had been abundant, though not excessive, so that the subsequent deficiency did not in the least interfere with the proper growth and maturity of immense crops throughout the State. We have here an excellent illustration of the principle, to which attention was called in my report for the year 1871, that a comparatively small amount of rain well distributed is much better than a larger amount unfavorably distributed.

3. The extremely small amount of snow is a marked meteorological peculiarity of the year.

4. We have a splendid example of the great advantage possessed by the State of Kansas in the long period of absence of severe frosts, so that a disaster occurring to the crops in the early part of the summer, may be fully retrieved by a second, third, or even a fourth planting. On the 15th of June, a large portion of Eastern Kansas had been shorn of vegetation, by the plague of the locusts. Yet corn planted from that date up to the 10th of July, in the desolated districts, yielded bountiful crops, the first severe frost of autumn occurring on the 30th of October, too late to damage the well-ripened ears.

The following is a summary of the weather for the year:

TEMPERATURE.

Mean temperature of the year, 50°.60, which is 2°.53 below the mean of the seven preceding years. The highest temperature was 99°, on the 22d of June. The lowest temperature was 16°.5 below zero, on the 9th of January. Mean temperature at 7 a.m., 44°.2; at 2 p.m., 60°.2; at 9 p.m., 48°.8.

Mean temperature of the winter months, 25.°62—3°.19 below the average; of the spring, 50°.60—2°.70 below the average; of the summer, 74°.87—2°.17 below the average; of the autumn, 51°.49—1°.04 below the average.

The coldest month of the year was January—the coldest January, and the coldest month on our record—with mean temperature 15°.60; the coldest week was January 8th–14th, with mean temperature 1°.94; the coldest days were January 13th and 14th, with mean temperature 7°.7 below zero. The mercury fell below zero 12 times, 9 of which were in January and 3 in February.

The hottest month of the year was July, with mean temperature of 76°.63; the hottest week was June 19th to 25th, mean temperature 83°.41; the hottest days were June 22d and July 16, which each had a mean temperature of 86°.6. The mercury reached or exceeded 90° on 32 days, viz: 3 in May, 13 in June, 8 in July, 2 in August, and 6 in September. There were 58 such days in 1874. The mercury did not reach 100° during the year.

The last light frost of spring was on May 4th; The first light frost of autumn was on September 18th, giving a period of 137 days entirely without frost. The last severe frost of spring was on April 17th; the first severe frost of autumn was on October 30th, giving a period of 196 days without severe frost. No cold weather during the year caused any damage to fruit.

RAIN.

The entire amount of rain, including melted snow, was 28.87 inches, which is precisely the same amount as in 1874, and falls below the average rainfall of the past eight years by 4.11 inches. Either rain or snow fell on 106 days, 4 more than the average number The longest interval without rain, during the growing season, March 1st to October 1st, was 18 days, June 8th to 27th. The number of thunder showers was 21.

SNOW.

The entire depth of snow was 5 inches, which is the least annual amount on our eight years' record, and is 20.36 inches below the average. Of this amount 4 inches fell in February and 1 inch in March. There were flurries of snow in January, April, November and December. The last snow flurry of spring was on April 12th; the first snow of autumn was on November 13th.

FACE OF THE SKY.

Average cloudiness of the year 44.81 per cent. of the sky, which is only .78 per cent. below the average. The number of clear days (less than one-third cloudy) was 162; half clear days (betwen one-third and two-thirds cloudy), 115; cloudy (more than two-thirds), 88. There were 23 days without a cloud, and an equal number without a trace of sky. June was the clearest month, with a mean cloudiness of 31.44 per cent. January was the cloudiest month, mean cloudiness 54.84 per cent. The mean cloudiness at 7 a. m., was 47.67 per cent.; at 2 p. m., 48.32 per cent.; at 9 p. m., 38.44 per cent.

DIRECTION OF THE WIND.

During the year (three observations daily) the wind was from the southwest 330 times; northwest, 298 times; southeast, 161 times; northeast, 135 times; south, 61 times; east, 47 times; north, 38 times; west, 10 times; calm, 15 times. The south (including southeast, south and southwest) winds outnumbered the north (including northeast, north and northwest) winds in the ratio of 552 to 471.

VELOCITY OF THE WIND.

The number of miles traveled by the wind during the year was 145,316. This gives a mean daily velocity of 398.12 miles, and a mean hourly velocity of 16.59 miles. The position of the anemometer cups at an elevation of 105 feet above the top of Mt. Oread, 325 feet above the river level, secures exposure to the full force of the wind. The maximum velocity attained was 75 miles an hour, on January 8th. The greatest daily velocity was 1,070 miles, on February 3d The strongest winds were in March and April; the lightest were in July and August.

BAROMETER.

Mean height of the barometer column, 29.102 inches. Mean, at 7 a. m., 29.126 inches; at 2 p.m., 29.077 inches; at 9 p.m., 29.103 inches: maximum, 29.856 inches, at 7 a.m., January 9th; minimum, 28.344 inches, at 2 p.m., May 7th, giving a yearly range of 1.512 inches. The highest monthly mean was in January, 29.303 inches; the lowest was in May, 29.006 inches. The barometer observations are corrected for temperature, but not for elevation, thus affording the means of determining the altitude of our station.

RELATIVE HUMIDITY.

Mean for the year, 65.53; at 7 a. m., 77.35; at 2 p. m., 46.58; at 9 p. m., 72.68. The dampest month was January; humidity, 78.10. The driest month was April; humidity, 57.60. There were only five fogs during the year. The minimum humidity for any single observation was 9 per cent. of saturation, at 2 p. m., March 27th.

The following table gives the mean temperature, the extremes of temperature, the relative humidity and the rainfall for each month of the year 1875, and a comparison with preceding years:

Month.	Mean Temperature.	Maximum Temperature.	Minimum Temperature.	Relative Humidity.	Rainfall in Inches.	Excess or Deficiency of Rainfall.
January	15.60	46.0	—16.5	78.10	0.12	1.34 def.
February	21.92	55.0	— 8.0	74.72	0.80	0.16 def.
March	37.10	82.0	9.5	64.93	2.61	0.50 ex.
April	49.70	82.0	23.0	57.60	2.51	0.41 def.
May	65.00	95.0	30.0	60-30	3.39	0 31 def.
June	75.47	99.0	49.0	60.20	3.45	0.14 def.
July	76.63	97.5	65.0	73.05	6.60	2.02 ex.
August	72.50	91.0	55.0	68.08	2.90	1.51 def.
September	65.75	95.0	38.0	64.35	1.39	2.30 def.
October	53.18	86.0	25.0	56.23	1.16	1.35 def.
November	35.55	70.0	2.0	62.13	0.36	1.55 def.
December	39.35	73.0	0.0	66.66	3.55	1.88 ex.
Year 1875	50.60	99.0	—16.5	65.53	28.87	4.11 def.
" 1874	54.20	108.0	— 3.0	65.52	28.87	4.11 def.
" 1873	52.71	104.0	—26.0	64 06	32.94	0.04 def.
" 1872	51.90	97.0	—18.0	64.40	32.63	0.35 def.
" 1871	54.80	103.0	— 6.0	----------	33 23	0.25 ex.
" 1870	54.50	102.0	—10.0	68.40	31.38	1.60 def.
" 1869	50.99	96.0	— 5.0	----------	38.51	5.53 ex.
" 1868	53.36	101.0	—16.5	----------	37.42	4.44 ex.

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